CRS Delivering Bioactives

Newsletter

A publication of the Controlled Release Society

Volume 28 • Number 3 • 2011

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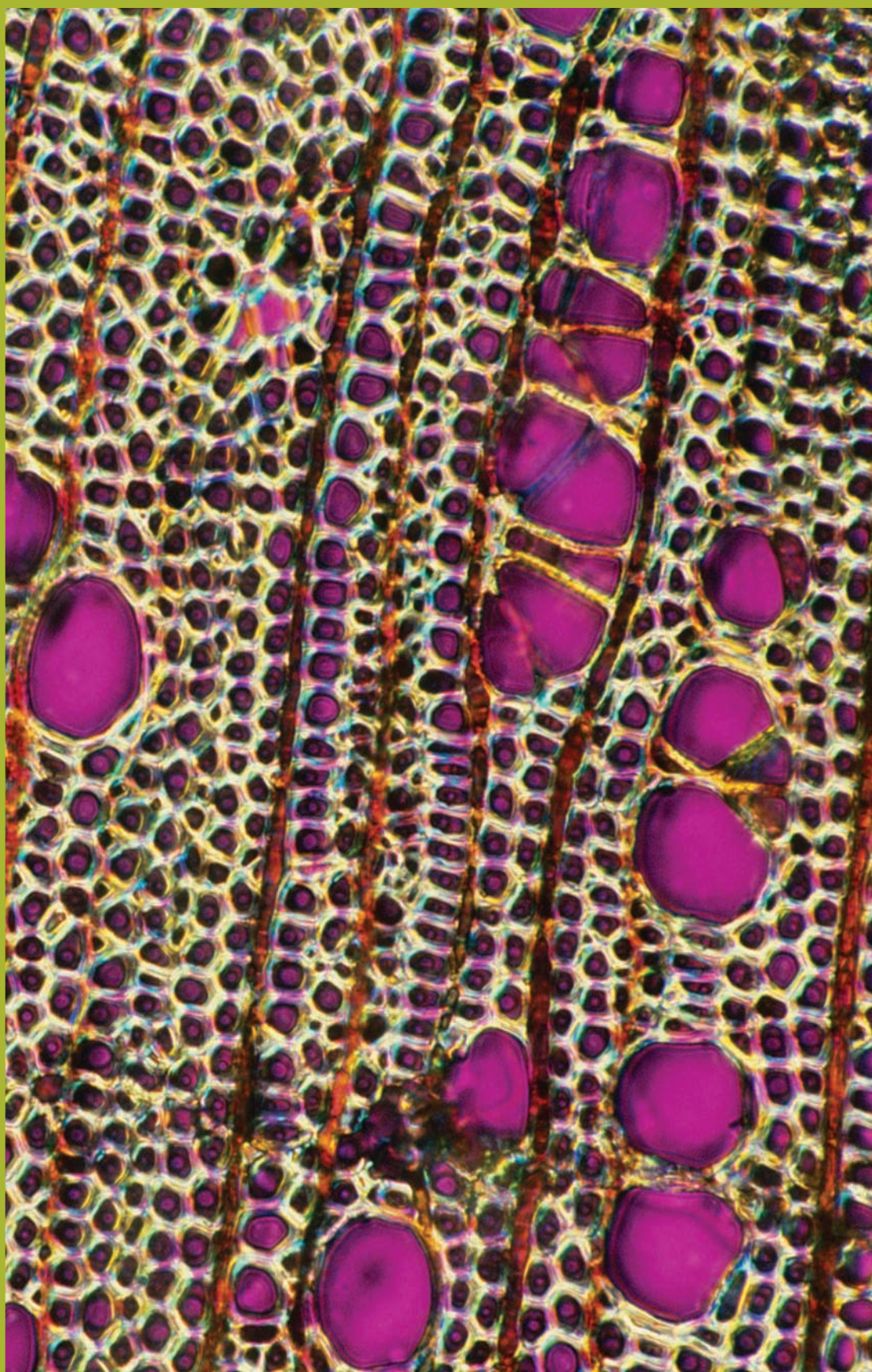

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CRS Delivering Bioactives

2011 CRS Young Investigator Award

Professor Molly M. Stevens
Research Director for
Biomedical Materials
Imperial College London

We congratulate Professor Molly M. Stevens, winner of the 2011 CRS Young Investigator Award.

- Attend Professor Stevens' presentation: *Engineering Biomaterials for Organs and Other Small Challenges,* at the Opening General Session, taking place on Monday, August 1 between 7:45-9:30 a.m.
- Professor Stevens will be presented with her award at the Opening General Session on Monday, August 1

Aptalis Pharmaceutical Technologies is the proud continuing sponsor of the CRS Young Investigator Award.

Aptalis Pharmaceutical Technologies is committed to advancing the sciences of pharmaceutical technologies through continued support of young investigators and investment in novel research. Visit us at **Booth #318** or contact us on our new website.

www.AptalisPharmaceuticalTechnologies.com

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The CRS Newsletter is the official newsletter of the Controlled Release Society. The newsletter is published six times annually providing scientific and technical information pertinent to the controlled release community and news about society and chapter activities. Members can receive the newsletter via mail. The newsletter may also be viewed online at www.controlledreleasesociety.org.

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Contact dwoodard@scisoc.org for information about exhibiting, advertising or other visibility opportunities.

Yvonne Perrie
Aston University, School of Life and Health Sciences
Aston Triangle, Birmingham, U.K.

Should Science Fiction be given an Impact Factor?

Dear Reader,

The new Impact Factors are out and the Journal of Controlled Release is up again. To see such continued interest in our research area is great news for the Journal and for us all within the Society. Not wishing to detract from this excellent achievement, yet given the drive to use such metrics to measure the quality of our science, the question remains – what is Impact? For example, if I were to say, *"the force is strong in this one,"* I suspect this would not be an unfamiliar quote to most of you; it ranks amongst the most memorable quotes from the infamous sci-fi *Star Wars* films. Indeed, for those who are *Star Wars* fans, let me move into Yoda dialect and say – *"great example of impact perhaps this is. Yes hmmn"* (if translate this you must, go to www.yodaspeak.co.uk). But enough of the *Star Wars* jokes, there is no denying the impact sci-fi can have in terms of capturing people's attention, so should we be concerned with the manner in which science is represented in such movies? Some people are becoming concerned with the prevalence of bad science in science fiction movies; to me it is instantly clarified by the "fiction" classification it carries – much like we can have movies about wizards or vampires without it making us check if Hogwarts do a Pharmacy degree, surely the same is true for science fiction movies, i.e., they are indeed fiction. Yet some people are becoming upset about the bad science in these movies. For example, issues listed for *Star Wars* include the fact there are sounds in space, the portrayal that all planets have Earth's gravity, the ability to easily chat with aliens, faster-than-light travel, and on YouTube, Brian Malow gets upset with Han Solo incorrectly using parsec as a unit of time (a parsec is a unit of distance equal to ~19 trillion miles). Clearly, if *Star Wars* had gone through peer-review, such errors would have been picked up and George Lucas would have received the dreaded "… we regret to inform you…" letter. However, this is no trivial matter to some; indeed, this angst against the use of bad science in movies has gone so far as to prompt some scientists to ask filmmakers to better follow the rules of science (http://news.bbc.co.uk/1/hi/magazine/8530405.stm). Seriously, would it not be better to focus on bad science in the real world – homeopathy for a start. Now there is a piece of fiction if ever there was one. Unfortunately, this is not part of a harmless movie storyline; these products can be found in many pharmacy shelves and misguided beliefs in the efficacy of homeopathic products can be dangerous through fanciful ideas such as their ability to provide "alternative" malaria prophylactics. Such stories of "magical water" fit better in the world of Harry Potter than in modern day healthcare.

But don't panic. Here is our Newsletter; we are strictly Science Fact, and we have another great lineup for you which is a mix of original science, chapter news, and an update on what is going on in the news and in the Society. So I hope you enjoy our newsletter and I look forward to seeing you in Maryland.

Until then, may the Force be with you.

Yvonne Perrie ■

Mark A. Tracy
Alnylam Inc.
Cambridge, MA, U.S.A.

The future is now! What we do today blazes the trail and is a key to defining our tomorrow. So, as we prepare to meet together at the end of July at our Annual Meeting, I want to summarize the trail we are making for CRS and where I think it may lead, which I believe is a bright and exciting direction for our members.

The first "leg of the stool" has been to strengthen and enhance our ties to our leaders and update our management. To this end, the CRS Board has approved the creation of the College of Fellows, formalized our volunteer Leadership Team, and approved a reorganization of CRS staff. Now, moving forward, we can further develop each of these groups to help advance the ambitious goals of the Society and to help in communicating who we are and what we do to key stakeholders worldwide. Regarding management, most notably our staff leadership and marketing resources have been strengthened through the reorganization. Also on leadership, we look forward to welcoming Ian Tucker, recently elected Vice-President and President-elect for 2012–13, onto the Board at our Annual Meeting.

The "second leg" has been to update our governance. We have recently completed the vote by the membership on the new bylaws. I am very pleased to announce that the new bylaws have been approved overwhelmingly by the CRS membership. Our new bylaws will help to strengthen the CRS by allowing greater flexibility and nimbleness to respond to change, promoting diversity and experience in our leadership, and updating our governance consistent with best practices in society management.

The "third leg" is to enhance our ability to advance the science and technology of delivery worldwide year-round. An enhanced CRS internet presence is essential to enable us to fully achieve this goal. To this end, we are about to launch a new website and formally kick off our webinar library. But this is just the beginning. Increasingly, we will need to capture our meeting content and put it on the website to allow access to a wider number of people. To complement our long-standing strength in promoting delivery research, we will also need to enhance our efforts in developing thought-leading content for meetings and the website in delivery translational research, product development, preclinical/clinical development, and regulatory science. We will need to use the website to highlight the diversity of our field, enhance networking including greater use of social media, and connect our chapters around the world and share their science. We can even use the website to build a curriculum for delivery science and to offer students accreditation in the field of delivery science and technology. Our electronic presence will need to be an area of significant growth and concentration for the Society over the next couple years to realize the potential of the new website. In essence, over time, with the support of our members and chapters, our website has the potential to become the world-leading resource for our field.

The "fourth leg" has been to lay a foundation for enhanced financial strength. We have established a Budget Oversight Subcommittee, multi-year financial planning, and are updating our strategic plan and annual meeting structure. All of these efforts will help us to build the financial resources needed to invest in new or improved programs and benefits over time. We have already begun with the new journal, *Drug Delivery and Translational Research,* the new website, and the upcoming book series.

In summary, we are strengthening all the parts of the CRS pyramid. At its base is leadership and governance. Above that is strategic planning and long-term financial management, and management and infrastructure (e.g., the website). At the tip of the pyramid are the member benefits: meetings, journals, books, webinars, etc. The strong foundation of the pyramid provides the basis to create enhanced benefits year round for you, our members, over the coming years. This is the bright and exciting direction I spoke of above. So please spread the word. All this will take the commitment of our volunteers, staff, and members. If you are interested in getting more involved in building the CRS of the future, let me know.

Finally, I would like to take a moment to thank the CRS staff, my fellow Board members, and our volunteer Leadership Team for your time and dedication to the CRS. A special thanks to all CRS volunteers. I recognize that your time is your most precious gift. I am grateful you chose to dedicate some of your valuable time to CRS this year. I look forward to seeing you soon at our Annual Meeting. Thank you! ■

Welcome to the 38th Annual Meeting & Exposition of the Controlled Release Society

Innovative and Low-Cost Technologies for Healthcare and Consumer Products

July 30 – August 3, 2011

Join leaders in delivery science from around the world at the 38th Annual Meeting & Exposition of the Controlled Release Society. The industry's premier meeting takes place in beautiful National Harbor, Maryland, and is located just 11 miles from Washington, DC. Discover the latest innovations in delivery science, and meet with colleagues that can advance your research and your career. For complete session descriptions and to register visit www.controlledreleasesociety.org/meeting/default.cfm. **Make Your Plans Now!**

2011 CRS Annual Meeting & Exposition Daily Schedule

Saturday, July 30

08:00 – 16:30	**Educational Workshop I:** *CNS Drug Delivery: From Proof of Concept to Clinical Readiness** *Cosponsored by Shire HGT and Alnylam Pharmaceuticals, Inc.*
08:00 – 17:00	Exhibit Set-Up
08:00 – 17:20	**Educational Workshop II:** *Introduction to Encapsulation and Controlled Release Technologies**
08:30 – 16:45	Young Scientist Workshop I: *Understanding siRNA*
12:00 –15:00	Attendee Services Desk/CRS Central Open

Sunday, July 31 • CRS Innovation Sunday

Cosponsored by Pfizer

07:30 – 18:00	Attendee Services Desk/CRS Central Open
08:00 – 12:00	**Educational Workshop I:** *CNS Drug Delivery: From Proof of Concept to Clinical Readiness* (continued)* *Cosponsored by Shire HGTand Alnylam Pharmaceuticals, Inc.*
08:00 – 12:00	**Educational Workshop II:** *Introduction to Encapsulation and Controlled Release Technologies* (continued)*
08:00 – 12:00	**Educational Workshop III:** *Pharmacologic and Regulatory Issues for the Translational Development of Nanoparticle Agents** *Cosponsored by Alnylam Pharmaceuticals, Inc.*
08:00 – 12:00	**Young Scientist Workshop II**: *Professional and Self-Development for Young Scientists and Protégés*
08:00 – 14:00	Exhibit Set-Up
08:30 – 13:15	**Releasing Technology Workshops**
08:30 – 17:30	CRS Partnering *Sponsored by Valeo Partners*
11:15 – 13:30	**Soapbox Sessions** *Cosponsored by Catalent*
11:30 – 12:30	First Timers' Meeting/Volunteer Fair
13:35 – 14:35	**Industry Roundtable:** *Drug Delivery Needs in the Age of Mergers, Acquisitions, and Out Licensing*
14:40 – 17:30	**Nanomedicine Product Development Summit** *Cosponsored by Alnylam Pharmaceuticals, Inc. and NanoImaging Services, Inc.*
17:30 – 19:30	**Exposition Opening and Welcome Reception**

Monday, August 1

07:00 – 08:00	Get Up! Get Educated!
07:00 – 18:00	Attendee Services Desk/CRS Central Open
07:45 – 09:30	Opening Session
09:30 – 10:30	**Exposition/Posters/Networking**
09:30 – 10:30	**Poster Session I:** Authors Present *Cosponsored by AstraZeneca*
09:30 – 14:00	CRS Partnering *Sponsored by Valeo Partners*
09:30 – 17:00	**Exposition/Poster Hall Open**
10:30 – 12:00	**Consumer & Diversified Products:** *Delivering Technologies for the Skin, Personal and Homecare*
10:30 – 12:30	**Bioactive Materials:** *Clinical Evaluations of Novel Drug Delivery Systems*
10:30 – 12:30	**Bioactive Materials:** *Medical Devices*
10:30 – 12:30	**Bioactive Materials:** *Pulmonary Delivery*
10:30 – 12:30	**Mini-Symposium:** *Application of Quality by Design (QbD) to Development of Pediatric Formulations and Dosage Forms, Part I*
10:30 – 12:30	**Mini-Symposium:** *Bioresponsive Systems*
12:30 – 13:00	Tablet and Capsule Manufacturing Focus Group
12:30 – 14:00	Nanomedicine Roundtable and Focus Group
12:30 – 14:00	Ocular Drug Delivery Roundtable and Focus Group
12:30 – 14:00	Oral Drug Delivery Roundtable and Focus Group *Cosponsored by Colorcon, Inc.*
12:30 – 14:00	Women in Science Forum Luncheon *Cosponsored by Roche*
12:30 – 14:00	**Young Scientist Roundtable:** *A How-To Guide to Peer Review*
13:00 – 14:00	Plenary Panel Discussion: *Impacting Global Health Through Nanotechnology*
14:00 – 15:00	**Plenary Speaker: Walter Orenstein.** *Critical Factors in the Making of Immunization Policy*
15:00 – 16:00	**Exposition/Poster Session I/ Networking**
15:00 – 16:30	**Mini-Symposium:** *Application of Quality by Design (QbD) to Development of Pediatric Formulations and Dosage Forms, Part II*
15:00 – 17:00	CRS Partnering *Sponsored by Valeo Partners*

16:00 – 17:30 Consumer & Diversified Products: *Microencapsulation in Foods, Flavors, and Nutraceuticals*
16:00 – 18:00 **Bioactive Materials:** *Biomaterials*
16:00 – 18:00 **Bioactive Materials:** *Intracellular Delivery*
16:00 – 18:00 **Bioactive Materials:** *Ophthalmic*
16:00 – 18:00 **Mini-Symposium:** *Microdevices*
18:00 – 19:30 Vet Get Together
Cosponsored by Pfizer Animal Health
21:00 – 23:00 Networking Night
Cosponsored by Encap Drug Delivery, Phoenix Pharmaceuticals, and Upsher-Smith Labs

Tuesday, August 2

07:00 – 08:00 Get Up! Get Educated!
07:00 – 17:30 Attendee Services Desk/CRS Central Open
08:00 – 09:00 **Plenary Speaker: Gordon Muirhead.**
Continuous Processing: Powder In, Tablets Out.
09:00 – 10:00 **Exposition/Poster Session II/Networking**
09:00 – 10:00 **Poster Session II:** Authors Present
Cosponsored by AstraZeneca
09:00 – 13:30 CRS Partnering
Sponsored by Valeo Partners
09:00 – 17:00 Exposition/Poster Hall Open
10:00 – 11:30 **Mini-Symposium:** *Application of Quality by Design (QbD)to Development of Pediatric Formulations and Dosage Forms, Part III*
10:00 – 11:45 **Bioactive Materials:** *Regenerative Medicine Technologies*
10:00 – 11:45 **Consumer & Diversified Products:** *Nanoparticles, Nanospheres and Nanopolymers*
10:00 – 12:00 **Bioactive Materials:** *Diagnostics*
10:00 – 12:00 **Bioactive Materials:** *Vaccines*
10:00 – 12:00 **Mini-Symposium:** *Cancer Therapeutics*
12:00 – 13:30 **Young Scientist Mentor Protégé/Meet and Greet**
12:30 – 13:30 Plenary Panel Discussion: *Pharmaceutical Product Development: From Concept to Clinic*
13:30 – 14:30 **Plenary Speaker: Adam Heller.** *Focusing on the Need of the Patient in Medical Innovation*
14:30 – 15:30 **Exposition/Poster Session II/Networking**
14:30 – 17:00 CRS Partnering
Sponsored by Valeo Partners
15:00 – 17:00 **Mini-Symposium:** *Application of Quality by Design (QbD) to Development of Pediatric Formulations and Dosage Forms, Part IV*
15:30 – 17:15 **Consumer & Diversified Products:** *Characterization of Controlled Release Systems*
15:30 – 17:30 **Bioactive Materials:** *Functionalised Nanoparticles*
Cosponsored by Northern Lipids Inc.
15:30 – 17:30 **Bioactive Materials:** *Oncology and Tumour Targeting*
15:30 – 17:30 **Bioactive Materials:** *Transdermal Delivery*
Cosponsored by 3M Drug Delivery Systems and Mylan Technologies
15:30 – 17:30 **Mini-Symposium:** *Biological Research Tools*
17:30 – 18:30 **Pearls of Wisdom Sessions**
Veterinary cosponsored by Merial

Wednesday, August 3

07:45 – 13:30 Attendee Services Desk/CRS Central Open
08:00 – 09:00 **Plenary Speaker: Henry Brem.** *Challenges of Therapeutic Delivery to the Brain.*
09:00 – 10:00 **Poster Session III:** Authors Present
Cosponsored by AstraZeneca
09:00 – 10:30 **Exposition/Poster Session III/Networking**
09:00 – 11:00 Exposition/Poster Hall Open
09:00 – 10:30 CRS Partnering
Sponsored by Valeo Partners
10:30 – 12:30 Bottlenecks in the FDA Regulatory Approval Pathway
Presented and Sponsored by American Institute for Medical and Biological Engineering (AIMBE)
10:30 – 12:30 **Bioactive Materials:** *Delivery to the Brain*
10:30 – 12:30 **Bioactive Materials:** *Pharmaceutical Manufacturing*
10:30 – 12:30 **Bioactive Materials:** *Protein Delivery*
10:30 – 12:30 **Consumer & Diversified Products:** *Regulations of Microencapsulated Products*
10:30 – 12:30 **Mini-Symposium:** *Exploiting the Nanoscale to Deliver Poorly Soluble Drugs*
10:30 – 12:30 **Veterinary:** *New Frontiers in Drug Development:Translational Research and Models for Veterinary and Human Health, Part I*
12:45 – 13:45 Plenary Panel Discussion: *Healthcare of the Future: How Pharmaceutical Advances Are Changing Medical Practice*
13:50 – 14:50 **Plenary Speaker: Gordon Amidon.** *Optimal Oral Delivery: From Empiricism to Mechanism*
15:00 – 17:00 **Bioactive Materials:** *DNA and RNA Delivery*
15:00 – 17:00 **Bioactive Materials:** *Microspheres*
15:00 – 17:00 **Bioactive Materials:** *Mucosal Delivery (nasal, vaginal, buccal, and rectal)*
15:00 – 17:00 **Bioactive Materials:** *New Polymer Chemistries*
15:00 – 17:00 **Bioactive Materials:** *Oral Controlled Release*
15:00 – 17:00 **Consumer & Diversified Products:** *Advances in Cyclodextrins for CR Applications*
15:00 – 17:00 **Veterinary:** *New Frontiers in Drug Development: Translational Research and Models for Veterinary and Human Health,Part II*

**Additional registration required.*

CRS Innovation Sunday

Cosponsored by Pfizer

Turning Emerging Delivery Science into New Products

Science • Partnering • Development • Commercialization

Build your networks for success during the second annual CRS Innovation Sunday! Partnering, technology, innovation, big pharma, entrepreneurs, research, development, regulatory approval, commercialization. You will find all of these elements in the fast-paced programming focused on taking innovative science through development and into the commercial sector. By attending, you will have the opportunity to network with players from multiple areas of controlled release and delivery. CRS Partnering also begins on Sunday!

Releasing Technology Workshops

Hosted by individual companies, these 1- and 2-hour workshops focus on in-depth facets of products and services supporting research and development in controlled release technologies. Releasing Technology Workshops (RTWs) are open to all registered attendees.

Soapbox Sessions

Cosponsored by Catalent

The Soapbox Sessions introduce the latest, most novel technologies, products, and services for controlled delivery in bioactive materials, consumer and diversified products, and animal health. Identify new ideas and potential collaborations in these fast-paced presentations and during the one-on-one sessions following the presentations.

Industry Roundtable: Drug Delivery Needs in the Age of Mergers, Acquisitions, and Out Licensing

Moderator: **Debra Bingham**, Valeo Partners

Speakers: **Marcus Brewster**, Johnson & Johnson; **Julia Rashba-Step**, Pfizer BioTherapeutics R&D; and **Anand Subramony**, Novartis Institutes for BioMedical Research

This interactive roundtable focuses on the needs of multinational biopharmaceutical companies and the various types of mergers and deals they are entering into to pursue their commercialization paths. Presenters will be senior industry executives who have been responsible for securing major agreements and integrating subsequent R&D functions with international partners. Why do executives choose particular agreements? What do these organizations need from the drug delivery community? How have the M&A activities altered their pipelines? What lessons did they experience along the way? Learn about the paths these companies have chosen and understand the impact on future requirements of controlled release and delivery technologies toward commercial success.

NEW! Nanomedicine Product Development Summit

Turning Nanoparticle Delivery Systems into Innovative Medicines

Chairs: **Rogério Gaspar**, University of Lisbon, Portugal, and **Mark Tracy**, Alnylam, Inc., U.S.A.

Come and participate in panel discussions with leaders in the development , regulatory review and commercialization of nanoparticle-based systems for the delivery of small molecules and siRNA to share experiences and discuss the latest science, challenges, and paths forward in developing new medicines based on nanoparticle delivery technologies. Be a part of the dialogue to facilitate advancement of these products through the clinic and regulatory approval process.

Panel Discussion 1: Formulation and Characterization of Nanoparticle Delivery Systems for siRNA and Small Molecules

Pieter Cullis, University of British Columbia, Canada
Scott McNeil, National Cancer Institute, U.S.A.
William Zamboni, University of North Carolina, U.S.A.

Panel Discussion 2: Development and Regulatory Considerations for Nanoparticle-based Medicines

Neil Desai, Celgene, Inc., U.S.A.
Lawrence Mayer, Celator Pharmaceuticals, U.S.A.
Sara Nochur, Alnylam Pharmaceuticals, Inc. U.S.A
Nikissa Sadrieh, CDER, FDA, U.S.A.
Beatriz Lima, Infarmed, University of Lisbon, Portugal

Exposition Opening and Welcome Reception

CRS Innovation Sunday culminates in the Exposition Hall with the Exposition Grand Opening and Welcome Reception. Join 100+ exhibiting companies and more than 1,600 attendees where products, services, and innovations can be discussed one-on-one.

38th Annual Meeting & Exposition of the Controlled Release Society

July 30 – August 3, 2011
Gaylord National Hotel & Convention Center
National Harbor, Maryland, U.S.A.

Innovative and Low-Cost Technologies for Healthcare and Consumer Products

Featured Plenary Speakers

Gordon Amidon
Professor of Pharmacy,
University of Michigan, U.S.A.

Henry Brem
Chair of Neurosurgery,
Johns Hopkins Hospital, U.S.A.

Adam Heller
Research Professor,
University of Texas, Austin, U.S.A.

Gordon Muirhead
Vice President and Dose Form Leader,
GlaxoSmithKline, United Kingdom

Walt Orenstein
Deputy Director for Immunization Programs, Vaccine Delivery, Global Health Program,
Gates Foundation, U.S.A.

Register for this premier event now! Plus, stay in the center of the action when you book your room at the Gaylord National Hotel.

CRS
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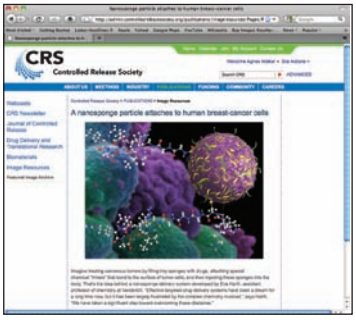
www.controlledreleasesociety.org

CRS Launches New Website to Better Serve Members

The CRS website committee is proud to announce the new www.controlledreleasesociety.org. The forward-thinking website is complete with news, resources, and networking opportunities designed to help our members advance. The dynamic homepage features news from around the globe, the latest research, and the most recent announcements about Society activities. The homepage will be regularly updated, becoming your dashboard for the latest information in delivery science.

The new home for delivery scientists – with dynamic content

The easy-to-use navigation helps you get to the information you need quickly. In addition, the featured images and editor's picks helps highlight the outstanding research that our members are doing. The editor's picks, taken from the *Journal of Controlled Release* and *Drug Delivery and Translational Research*, are archived, making them always available for your reference. There are also more opportunities for members to participate by sending in their featured images to be included on the homepage—click the featured image to learn more.



Send your images to be a part of the CRS website

The new resources included in this site include an expanded library of peer-reviewed webcasts, spanning four categories: educational, research papers, industrial, and presentations from annual meetings. These will only be available to members, to offer you the chance to learn from leaders in the field, keep up to date on issues affecting your industry, and see presentations missed at the annual meeting. Also launching with the website is LATTE – Linking Academic Technologies and Techniques to Everyone. LATTE is available to CRS members, and is a unique database allowing members to search for experts. With this new feature, you will be able to easily identify individuals for collaboration, consultation, or expert opinion. CRS members are now invited to participate in this innovative new initiative.

The webcast library is free for members

In addition, there are an increased number of opportunities for you to connect with colleagues. By clicking "Community" you can access the member directory, the growing chapter network, and more. If you are looking for a new job, the "Careers" area has been improved and expanded, helping you plan your next move in the field of delivery science.

Connect with colleagues faster with the new Community area

The new website is integrated with the member database, so that once logged in, members can access their information, sign up for a meeting, purchase a journal subscription, and more. Members must log in to access unique content, such as the CRS newsletter, the webinar library, communities, the membership directory, LATTE, and more.

These are just a few features of the new website. Watch this space for expanded information on this major achievement for our Society or visit the new site now. ■

Thank you to the Website Design Ad Hoc Committee

Chair: Andrew L. Lewis, *Critical Pharmaceuticals*

Jake E. Barralet, *McGill University*
David J. Brayden, *University College Dublin*
Biana Godin Vilentchouk, *The Methodist Hospital Research Institute*
Karl Malcolm, *Queen's University of Belfast*
Xiaoming Xu, *University of Connecticut*
Diane J. Burgess, *University of Connecticut*

Soo Hyeon Lee Chosen as Tsuneji Nagai Postdoctoral Fellowship Winner

Soo Hyeon Lee of the Korea Advanced Institute of Science and Technology was chosen as the 2011 Tsuneji Nagai Postdoctoral Fellowship Winner, and will be receiving the $30,000 award from the award's namesake, Tsuneji Nagai, during the 38th CRS Annual Meeting & Exposition. Lee will also present a poster during the CRS Annual Meeting, and will serve as an invited speaker at the 2012 Annual Meeting to present outcomes of the research.

Soo Hyeon Lee

Chosen from a pool of extraordinary young scientists, Soo Hyeon Lee is currently in a postdoctoral position in the laboratory of late professor Tae Gwan Park, Department of Biological Sciences at KAIST (South Korea). She received a B.S. degree in biology from KAIST and a combined master's and doctoral degree in biology from KAIST, respectively in 2005 and 2011. During her Ph.D. studies under the supervision of Park, she developed an efficient siRNA delivery system by using novel siRNA-polymer conjugates. Her extensive experience includes co-publishing 24 papers, and she is the co-inventor on three patents. Lee was awarded the third and first prizes for the poster presentation from Roche Marco Polo Symposium, respectively in 2008 and 2009, and first prize from Bioneer Award in KAIST for contribution to academic-industrial cooperation with international patents (2010). Her research interests mainly focus on the design of polymer-based delivery systems for nucleic acid drugs. She will join the group of Jean-Christophe Leroux at ETH Zurich as a postdoctoral fellow in August 2011.

About the Fellowship

This new fellowship of the CRS Foundation honors Dr. Tsuneji Nagai, past president of the Controlled Release Society (CRS), whose work in bioavailability studies and controlled drug delivery formulations has contributed greatly to the pharmaceutical science of Japan, Asia, and the world. Beyond measure, he has influenced students and colleagues whose work continues to significantly impact delivery science. ■

CRS Election Results

Vice President

Dr. Ian Tucker
University of Otago, New Zealand

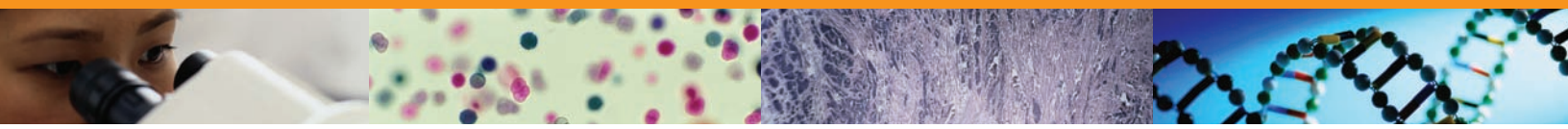
Congratulations to Ian Tucker, University of Otago, who was elected vice president of the Controlled Release Society. Mansoor Amiji, Northeastern University; Ben Boyd, Monash University; and Pavla Simerska, University of Queensland, were elected to the Board of Scientific Advisors (BSA). These new members will join the Board of Directors and the BSA, respectively, after the 2011 CRS Annual Meeting & Exposition in August 2011. Thank you to all of the impressive candidates who participated in this election. Thank you also to the CRS members who voted, helping decide the future of our society.

Board of Scientific Advisors

Dr. Mansoor Amiji
Northeastern University, Boston, MA

Dr. Ben Boyd
Monash University, Parkville, Australia

Dr. Pavla Simerska
University of Queensland, Brisbane, Australia



Consumer and Diversified Products (C&DP) Prepares for National Harbor

For the past year and a half, the Consumer and Diversified Products (C&DP) Program subcommittee has been organizing the C&DP technical program for this year's Annual Meeting and Exposition in National Harbor. The C&DP program will again bring an engaging representation of current controlled release research and technology in areas focused outside the pharmaceutical arena. The program includes six technical sessions, a two-day educational workshop on controlled release technologies, and a Pearls of Wisdom debate on regulations in the cosmetic industry. A C&DP group luncheon/dinner will again be held to help foster the continuing controlled release efforts in C&DP areas. A summary of the program is provided below:

C&DP Technical Sessions

Cosponsored by Coating Place, Inc.

Chaired by Jamileh Lakkis, Lipotec Group, Spain and Ronald Versic, Ronald T. Dodge Co., U.S.A.

Cyclodextrins
Helmut Viernstein, University of Vienna (Austria)

Characterization of Encapsulated Systems
Nicole Papen-Botterhuis, TNO Innovative Materials (The Netherlands)

Microencapsulation in Cosmetics, Personal and Homecare
J. W. Wiechers, J. W. Solutions (The Netherlands)

Microencapsulation in Foods, Flavors & Nutraceuticals
Colin Barrow, Deakin University (Australia)

Nanoparticles, Nanospheres and Nanopolymers
Simona Margutti, Naturwissenschaftliches und Medizinisches Institut (Germany)

Regulations of Microencapsulated Products
Norma Skolnik, EAS Consulting Group (U.S.A.)
Jeff Crowthers, Health Products Association (HPA) (China)
Dr. Sudesh Kamath, U.S. Food & Drug Admin Center for Veterinary Medicine (U.S.A.)

C&DP Educational Workshop

Introduction to Encapsulation and Controlled Release Technologies

Chaired by James Oxley, Southwest Research Institute, U.S.A. and Teresa Virgallito, Microtek Laboratories, Inc., U.S.A.

This workshop will provide the attendee with a broad overview of the encapsulation and controlled release technologies available, in addition to potential applications. Newcomers to the controlled release field will use this workshop as an introduction to the field, while established members may see this as an opportunity to refresh their knowledge or find ideas outside of their specific area of interest.

Saturday, July 30, 2011

James Oxley, SwRI, U.S.A., *Overview of Microencapsulation*
Irv Jacobs, Jacobs Consulting, U.S.A., *Spray Drying, Chilling, and Prilling*
Chuck Frey, Coatings Place Inc., U.S.A., *Fluid Bed Coating*
James Oxley, SwRI, U.S.A., *Coextrusion*
Teresa Virgallito, Microtek Labs, Inc., U.S.A., *Interfacial Polymerization, PUFA*
Ron Versic, R. T. Dodge, U.S.A., *Coacervation*
Teresa Virgallito, Microtek Labs, Inc., U.S.A., *Edible Films*
Hans Tromp, NIZO, The Netherlands, *Fibers*
Buket Aksu, Santa Farma, Turkey, *Applications – Pharma*
Teresa Virgallito, Microtek Labs, Inc., U.S.A., *Applications – Cosmetics*

Sunday, July 31, 2011

James Oxley, SwRI, U.S.A., *Nanoencapsulation*
Irv Jacobs, Jacobs Consulting, *Encapsulation Materials*
Anil Gaonkar, Kraft, U.S.A., *Applications – Food*
Michael Rathbone, Griffith University, Australia, *Applications – Veterinary*
Irv Jacobs, Jacobs Consulting, U.S.A., *Applications – Agricultural*

C&DP Pearls of Wisdom

Can the cosmetic industry live by its own regulations?

J. W. Wiechers, J. W. Solutions (The Netherlands)

What's On?

Did you know that 2011 is World Veterinary Year? The first veterinary school was founded in 1761 in France, so this year celebrates the 250 year anniversary of veterinary education. Many countries around the world are celebrating this anniversary by hosting conferences, workshops and seminars.

Find out what is happening in the area of animal health around the world and where your expertise on the science of controlled release and drug delivery can provide input. Here is a sample of what's on.

2011

June

Veterinary medicines legislative review – the big debate

The International Federation for Animal Health (IFAH-Europe) 2011 conference will be an opportunity to discuss the availability of veterinary medicines in Europe within a revised regulatory framework.

Date: June 15–16, 2011
Place: Brussels Renaissance Hotel, Brussels, Belgium
More information: http://www.ifaheurope.org/

Exploring Research and Development in Veterinary Medicine

This conference will showcase the latest research developments and innovative techniques used in R&D. Topics include emerging markets, discovery of new molecules and veterinary generics.

This conference will feature a presentation as part of the expert speaker panel by Prof. David Brayden, a previous Chair of the CRS Veterinary Committee.

Date: June 21–22, 2011
Place: H10 Marina Barcelona Hotel, Spain
More information: http://www.informaglobalevents.com/event/vetrd

July

Veterinary Pharmacy. What's it all about?

Royal Pharmaceutical Society is association with the Veterinary Pharmacists Group is holding a conference on veterinary pharmacy. Topics of the conference include the relevance to zoonoses to pharmacists in practice and medicines for companion animals.

Date: July 2–3, 2011
Place: The Royal York Hotel, York, United Kingdom
More information: www.rpharms.com/events

October

30th World Veterinary Congress

The theme of the conference is "Caring for animals: healthy communities" and there will be a focus on disease control in communities.

Date: October 10–14, 2011
Place: Cape Town International Convention Centre, Cape Town, South Africa
More information: http://www.worldvetcongress2011.com/

Rising to new heights of cancer care

The Veterinary Cancer Society is hosting a conference that will draw on experts in oncology including Dr. Basar Bilgicer who will conducts research on the design of therapeutic agents with improved targeting for cancers.

Date: November 4–7, 2011
Place: Embassy Suites Hotel, Albuquerque, New Mexico
More information: http://www.muconf.missouri.edu/vetcancer2011/

2012

July

7th World Congress of Veterinary Dermatology

An international meeting highlighting recent advances in veterinary dermatology in both clinical and scientific research. There will be scientific talks on the topics of new oncologic therapies for skin tumors and Mycobacterium infection in veterinary dermatology.

Date: July 24–28, 2012
Place: Vancouver Convention Centre, Vancouver, Canada
More information: http://www.vetdermvancouver.com/

Let us know if you have an event that you would like to be advertised in the *CRS Newsletter*. ■

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A Mesoporous Silicon-Based Material for the Delivery of Proteins in Bone Tissue Engineering

D. Fan,[1] M. Ferrari,[2] and E. Tasciotti[2]

Introduction

Porous silicon (pSi) materials have been widely investigated in drug delivery and tissue engineering applications due to their biocompatibility and biodegradability (1). Compared to other inorganic materials used as drug delivery systems, they feature many advantages especially in the realm of bone tissue engineering. Silicon based pSi matrices display high surface area and interconnected pores with different geometries (2). Overall porosity and pore size can be finely tuned ranging from approximately 2 nm to more than 50 nm (Figure 1) (2). The pSi particles both serve as reservoirs to store drugs and bioactive molecules as well as shelters to protect the payload from the degradation or denaturation due to the harsh exterior environment or to the enzymatic activity. Although these features make pSi a very promising material for drug delivery, there are a few limitations and challenges for the achievement of sustained release such as short degradation period and burst release.

In order to overcome these limitations and achieve controlled and sustained release rate, we envisioned to encapsulate pSi particles into polymeric microspheres. Our hypothesis was that the polymer layer could slow down the drug release rate while shielding the pSi particle from degradation, thus providing an additional layer of protection for the payload. In order to be released by this composite material, the drug is forced to first diffuse from the pores of the silicon matrix and then through the polymer layer. By playing with the thickness and density of the coating and in combination with its degradation, it is possible to tailor the release kinetics and rates of the therapeutic payload. PLGA is a biodegradable and biocompatible polymer approved by the Food and Drug Administration that has been widely used in drug delivery applications for tissue engineering (Figure 2). The major drawback that PLGA based microspheres face though is that the PLGA degradation results in the acidification of the environment, thus inducing inflammation and other side effects to the exposed cells and tissues (2). Compared to traditional PLGA material, the PLGA/pSi microspheres have unique and superior advantages (3). During the degradation of the composite particles, pSi can neutralize the acidic pH due to PLGA by-products to more physiologic levels. Furthermore, the non-toxic degradation product of pSi, orthosilicic acid, has the ability to stimulate collagen type 1 synthesis, which constitutes the essential matrix of bone (4), while the normal growth and adhesion of mesenchymal stem cells (osteoclast progenitors) was not affected.

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[2] The Methodist Hospital Research Institute, Houston, Texas. ETasciotti@tmhs.org, MFerrari@tmhs.org

Methods

PLGA/pSi microspheres were fabricated by a solid-in-oil-in-water (S/O/W) microemulsion method (Figure 3) (5). First, PLGA was dissolved in dichloromethane (DCM) to form different concentration of polymer solutions as needed. PSi particles were oxidized by hydrogen peroxide to achieve negative

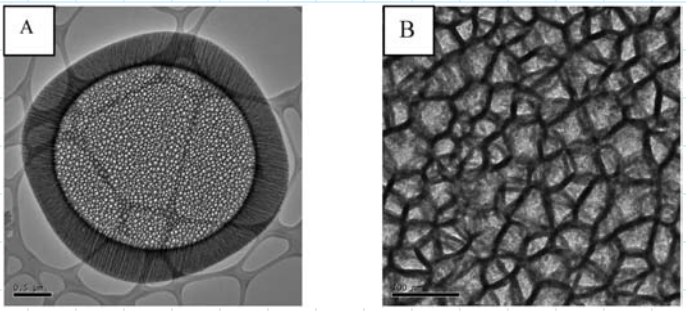

Figure 1. *Ultrastructure of a pSi particle as seen through transmission electron microscopy. The shape of pSi is hemispherical with highly interconnected pores. (A) The cross-section of a pSi particle. (B) The porous matrix at higher magnification.*

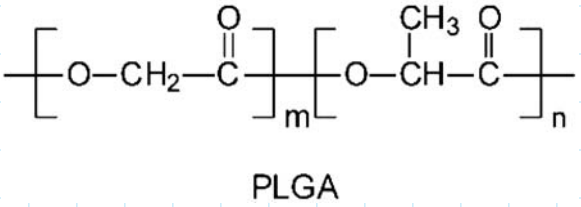

Figure 2. *Chemical structure of Poly (DL-latide-co-glycolide) (PLGA).*

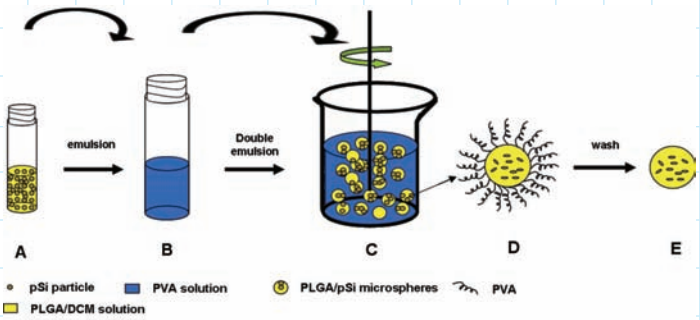

Figure 3. *Schematic of S/O/W method used to encapsulate pSi particles. A) pSi particles are evenly distributed in PLGA/DMC solution by vortex mixing and sonication. B) pSi/PLGA/DMC mixture is added drop-wise to an aqueous solution containing 2.5% PVA, stirring to form emulsion. C) The emulsion is added to another aqueous solution containing 0.5% PVA, stirring to evaporate DCM. D) Schematic of one PLGA/pSi microspheres with surfactant on the surface. E) Schematic of one PLGA/pSi microspheres after wash.*

Scientifically Speaking Fan continued on page 14

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charge on the surface of the particles. The oxidized particles were immersed into growth factor solution for 2 hr with gentle rotation to allow the positively charged growth factors (BMP-2) entering the negatively charged pores driven by capillary effect and electrical interaction. The BMP-2 loaded pSi particles were evenly distributed in the PLGA/DCM solution by vortex mixing and sonication. Then the mixture was poured into an aqueous solution containing polyvinyl alcohol (PVA) and stirred at a fixed speed to form emulsion. Then the emulsion was poured to another larger volume of PVA solution to evaporate DCM solvent. The morphology of the microspheres was characterized by scanning electron microscopy, optical microscopy, and confocal microscopy. In order to be used for drug delivery and bone tissue engineering, a series of studies were performed to test the applications of these composite microspheres. *In vitro* studies included payload release, composite degradation, protein stability studies, cell proliferation, differentiation, and mineralization. *In vivo* studies were also performed to prove bone regeneration in rats and sheep.

Results and Discussion

The PLGA/pSi microspheres are spherical and smooth (Figure 4A) structures with a size distribution from a few microns to approximately 50 microns. The pSi particles were fully encapsulated in the PLGA microspheres in a variable number according to the experimental conditions (Figure 4B). A controlled and sustained release rate was observed during the *in vitro* release studies and was characterized by a partial burst release (less than 10% of the payload) followed by a sustained release of the protein over 30 days. The mechanism of drug release occurs by diffusion during the concomitant erosion of the polymer layers. The growth factor molecules are first released from the pores of the pSi particles, and then diffuse to the exterior environment through the PLGA layers or through the areas where the polymer degradation occurred. The release rate of the proteins was tuned by adjusting the thickness and density of the PLGA layer. The thicker the PLGA layer, the slower the release rate of the growth factors. Differentiation and mineralization studies show that, in the presence of the BMP-2 loaded microspheres, cells have significantly higher alkaline phosphates activities and mineralization than the control groups while new bone formation was demonstrated in the *in vivo* studies in rat through histological studies.

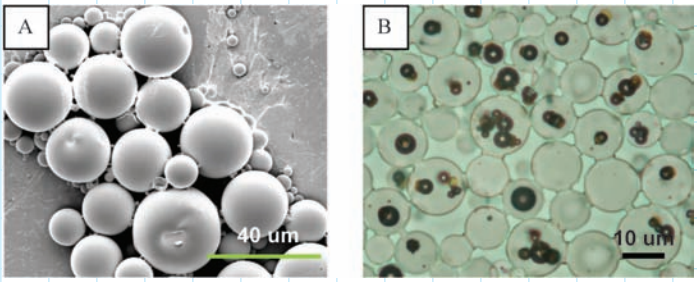

Figure 4. *PLGA/pSi microspheres fabricated by solid-in-oil-in-water method. (A) A scanning electron microscopyimage of PLGA/pSi microspheres show that their spherical and smooth surfaces. (B) The optical transmission microscopy image shows that pSi particles were fully encapsulated in the PLGA microspheres.*

Conclusions

Our novel drug delivery system based on PLGA/pSi microspheres can be efficiently fabricated by an S/O/W emulsion with high yields. The particles can be advantageously used for drug delivery in bone tissue engineering applications. This system is capable of preventing the burst release of proteins and sustaining the release rate over a long period of time as required in regenerative medicine. The system also prevent proteins denaturation by protecting them during fabrication and preserving their bioactivities as demonstrated in the *in vitro* mineralization studies and in our *in vivo* animal models. In conclusion, our study demonstrated that the PLGA/pSi microspheres represent a potential alternative to traditional PLGA based drug delivery vehicles for bone tissue engineering applications.

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Dr. Dongmei Fan received her Ph.D. degree in 2008 at the Department of Chemistry, College of Science and Engineering, Texas Christian University under the supervision of Prof. Jeffrey L. Coffer. After that, she joined Prof. Mauro Ferrari's group at the University of Texas Health Science Center at Houston as a postdoctoral fellow under the supervision of Dr. Ennio Tasciotti. Subsequently, she transferred to the Methodist Hospital Research Institute at Houston with Dr. Ferrari's group and holds a postdoctoral position there. Her research focuses on developing and fabricating new materials for drug delivery and orthopedic tissue engineering applications.

Dr. Mauro Ferrari is a founder of biomedical nano/micro-technology, especially in their applications to drug delivery, cell transplantation, implantable bioreactors, and other innovative therapeutic modalities. He serves as President and CEO of the Methodist Hospital Research Institute, where he holds the Ernest Cockrell Jr. Distinguished Endowed Chair. He is also Professor of Internal Medicine at the Weill Cornell Medical College, Adjunct Professor of Experimental Therapeutics The University of Texas M. D. Anderson Cancer Center, Professor of Bioengineering at Rice University, Adjunct Professor of Biomedical Engineering at UT Austin, and President of the Alliance for NanoHealth in Houston.

Dr. Ennio Tasciotti is currently a member of the Methodist Hospital Research Institute where he holds membership at the Department of Nanomedicine and serves as an Interim Co-Chair of Regenerative Medicine. He is also the Scientific Director of the Spine Advanced Technology Laboratory and is an Adjunct Professor at the University of Texas Graduate School of Biomedical Sciences at Houston. Dr. Tasciotti is the inventor of the multistage delivery system and is the team coordinator of the project "BioNanoScaffold for post-traumatic osteo-regeneration" awarded by the Defense Advanced Research Project Agency (DARPA) to develop new materials for bone regeneration.

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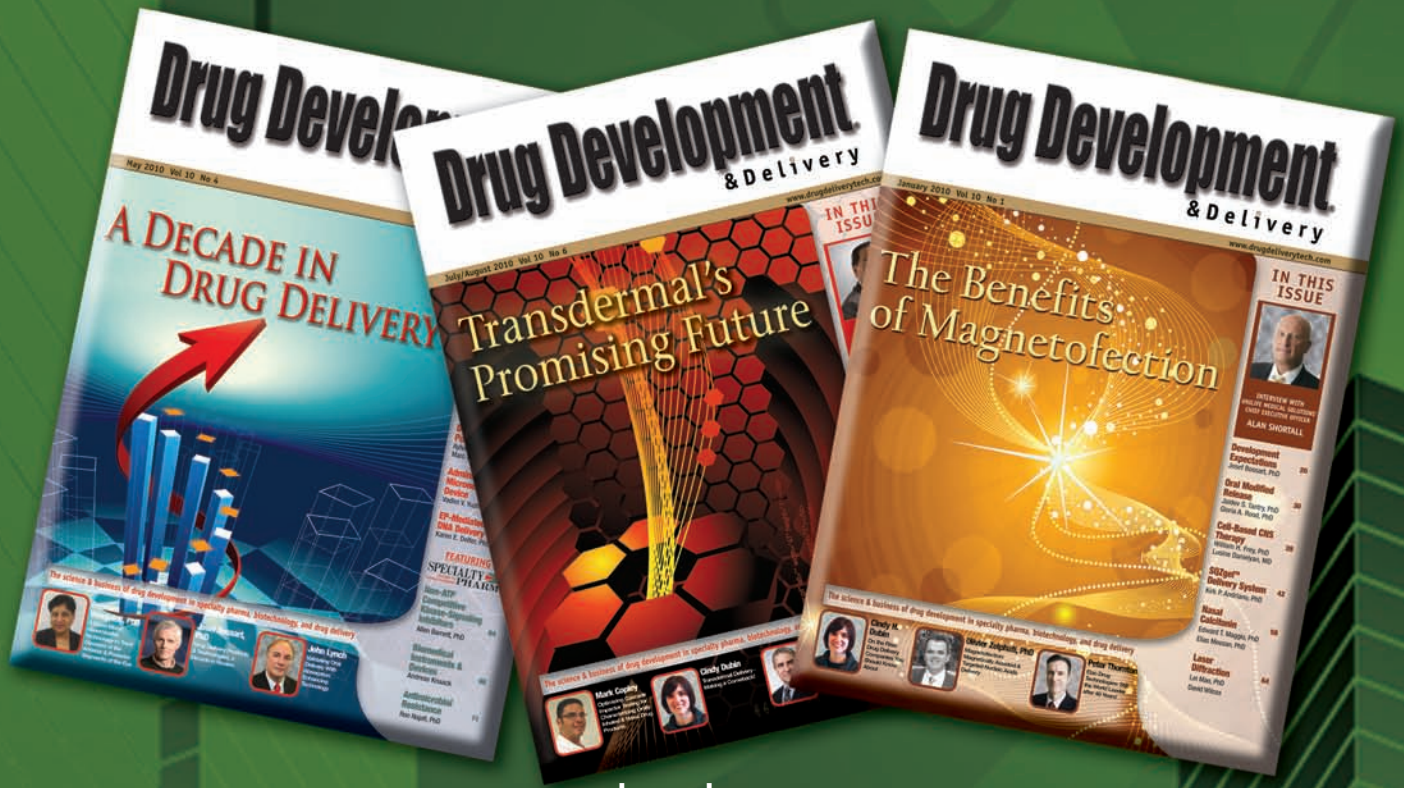

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Anti-Inflammatory and Antioxidant Polyoxalate Nanoparticles for Drug Delivery Applications

Hyunjin Park[1,†], Donghyun Hong[2], Gilson Khang[1], and Dongwon Lee[1,2,]*

Introduction

Reactive oxygen species (ROS) form as a natural byproduct of the normal cellular metabolism of oxygen and also serve as an essential physiological regulator as well as an important biological messenger in cell signal transduction cascades. However, the overproduction of ROS leads to oxidative stress, causing the significant damages to cell structures such as lipid, DNA, and proteins. Accumulation of oxidative stress damages over time is associated with many life-threatening diseases including asthma, Alzheimer's and related neurodegenerative diseases, arthrosclerosis, and cancer. Hydrogen peroxide is one of ROS and its overexpression causes oxidative damages to tissues and organs and has been implicated in inflammatory responses and aforementioned life-threatening diseases, despite its various beneficial roles. Nitric oxide (NO) is also recognized as an important immunomodulatory and cytotoxic mediator of inflammatory responses and the excessive NO production causes tissue damages. Therefore, ROS have great potential as a diagnostic and therapeutic biomarker of various inflammatory responses and there is increasing interest for the development of strategies to reduce oxidative stress.

Gastrodia elata has been a widely used herbal agent for the treatment of various inflammatory diseases in oriental countries due to its anti-inflammatory and antioxidant activities. *p*-Hydroxybenzyl alcohol (HBA) is one of the major active pharmaceutical ingredients of *Gastrodia elata* and plays a protective role against oxidative damage-related diseases. HBA is also a powerful scavenger of free radicals such as superoxide and hydroxyl radical. HBA is a diol aromatic molecule and may be suitable in the synthesis of polyoxalates which can be prepared from a one-step reaction of oxalyl chloride and diols. We thus developed fully biodegradable HBA-incorporated polyoxalate (HPOX), which contains HBA covalently in its backbone and release potent antioxidant HBA. Here, we describe the potent antioxidant and anti-inflammatory activities of HPOX nanoparticles.

Results and Discussion

HPOX was synthesized from a one step condensation between oxalyl chloride, 1,4-cyclohexanedimethanol, and HBA. In design, HPOX degrades hydrolytically into diols under physiological conditions. HPOX nanoparticles formulated by an oil-in-water emulsion method were round spheres (mean size ~550 nm) with smooth surfaces (Figure 1).

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In order to demonstrate the antioxidant activity of HPOX, the inflammatory responses of lipopolysaccharide(LPS)-treated RAW 264.7 macrophage cells were investigated in the absence or presence of HPOX nanoparticles. We examined the inhibitory effects of HPOX nanoparticles on LPS-induced NO production. During the incubation with LPS for 6 h, cells produced considerable amounts of NO, up to 13 μM. When cells were pretreated with HPOX nanoparticles, the NO production was significantly inhibited in a dose-dependent manner (Figure 2).

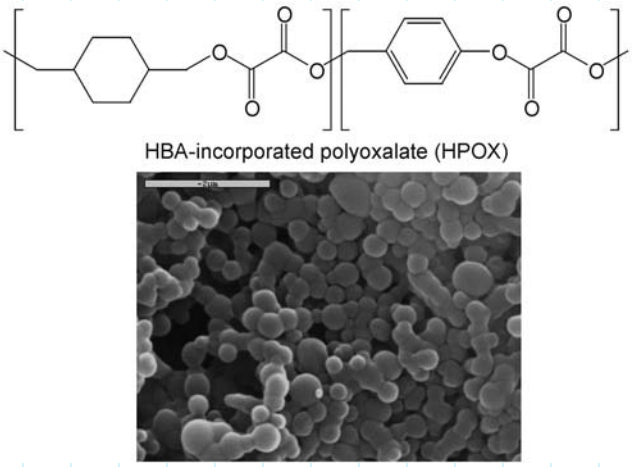

Figure 1. *Chemical structure of HPOX and microscopy of HPOX nanoparticles.*

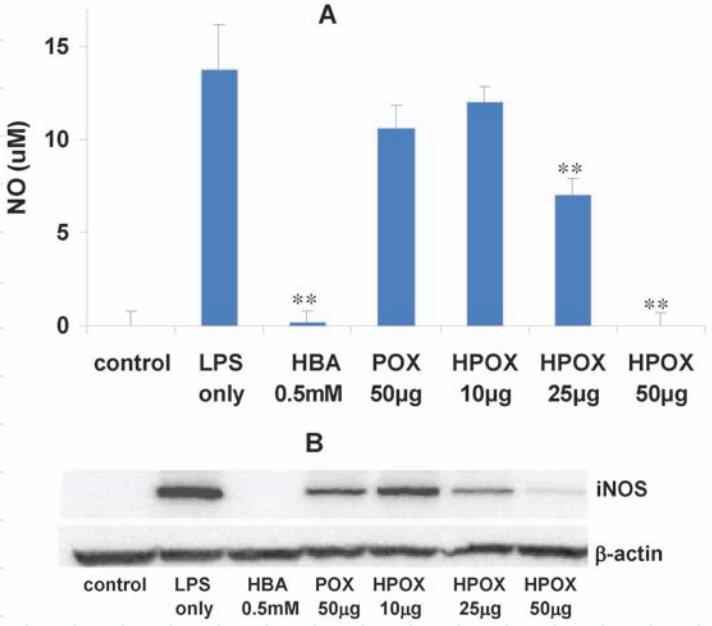

Figure 2. *Suppression of NO production by HPOX nanoparticles. A, the concentrations of NO measured using a Griess reagent; B, reduced expression of iNOS expression.*

Scientifically Speaking Park continued on page 18

Scientifically Speaking Park continued from page 17

After the treatment of 50 μg of HPOX nanoparticles, complete inhibition of NO production was observed.

With an assumption that the inhibition of NO generation by HPOX nanoparticles would be caused by the suppression of iNOS (inducible nitric oxide synthase) production, we examined the level of iNOS in LPS-stimulated macrophages. LPS-treated cells exhibited a high level of iNOS. HPOX nanoparticles suppressed the iNOS production dose-dependently without changes in the level of β-actin, an internal control. iNOS production was significantly inhibited by 50 μg of HPOX nanoparticles, demonstrating that HBA released from HPOX nanoparticles inhibits inflammatory NO by suppressing the iNOS expression.

We also investigated the scavenging and reduced production of intracellular ROS by HPOX nanoparticles using dichlorofluorescin-diacetate (DCFH-DA). Phorbol-12-myristate-13-acetate (PMA) was used to stimulate cells for ROS generation and the level of PMA-induced intracellular oxidants were observed. Cells given DCFH-DA only showed no or weak fluorescence (Figure 3). PMA-treated cells showed bright fluorescence because DCFH-DA was oxidized by PMA-mediated ROS to form dichlorofluorescein, which can emit a strong fluorescence. However, pretreatment with 0.5 mM of HBA resulted in the significant reduction of PMA-induced fluorescence due to its antioxidant activity. HPOX nanoparticles pretreatment also reduced significantly PMA-induced fluorescence in a dose dependent manner. More than 90% reduction of PMA-induced fluorescence was observed with 50 μg of HPOX nanoparticles.

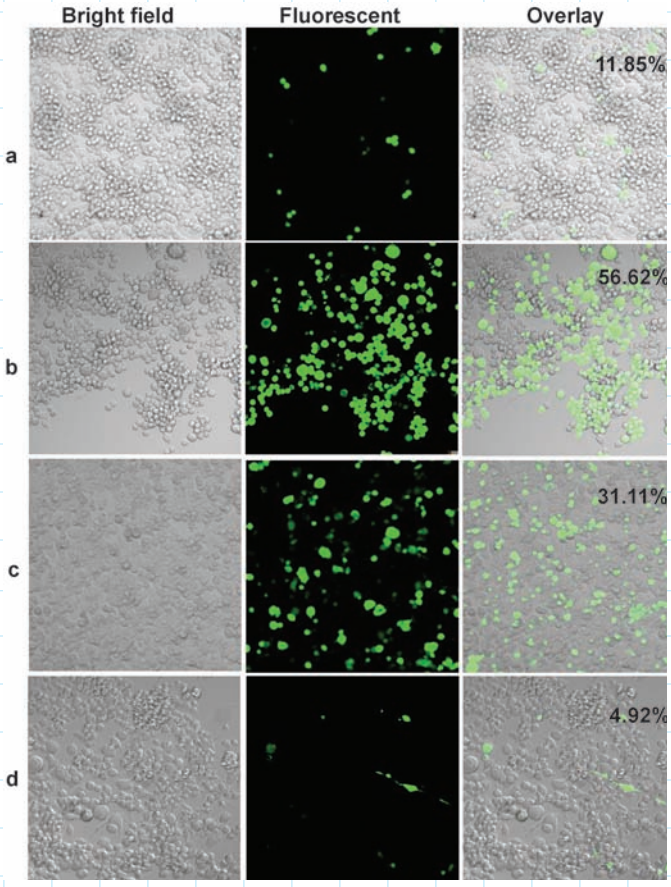

Figure 3. *Fluorescence images of RAW264.7 cells treated with 1 mg of PMA. A, cells were given DCFH-DA only; B, PMA-treated cells; C, PMA-pretreated cells with 62 mg of HBA; D, PMA-pretreated cells with 50 mg of HPOX nanoparticles. The values are the representative percentage of positive events calculated as the events within the gate divided by total number of events.*

We also evaluated the anti-inflammatory activities of HPOX by measuring the level of TNF-α of LPS-stimulated macrophages. Cells were pretreated with HPOX nanoparticles prior to being stimulated with LPS and the level of TNF-α was measured at 6 h post treatment (Figure 4). The LPS treatment resulted in significant increase in TNF-α production in macrophages. HPOX nanoparticles attenuated the LPS-induced TNF-α production in a dose-dependant manner. HPOX nanoparticles with less than 50 μg showed a slight reduction of TNF-α production, but not significant. The significant inhibition (~40% reduction) of TNF-α production was observed with 100 μg of HPOX nanoparticles. These results support that HBA released from HPOX nanoparticles reduces the generation of TNF-α and exerts anti-inflammatory effects.

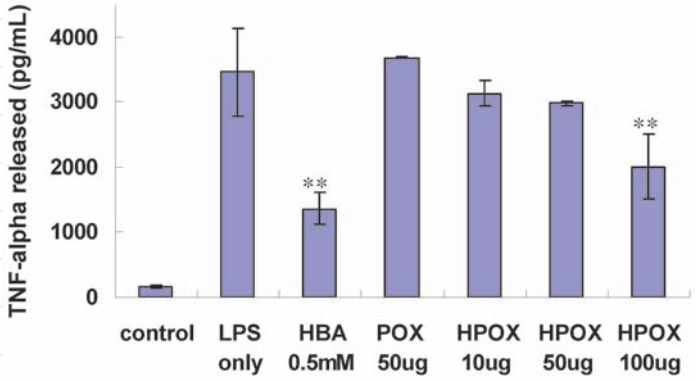

Figure 4. *Reduced production of TNF-a by HPOX nanoparticles.*

Conclusions

We prepared new fully biodegradable HPOX nanoparticles with potent antioxidant and anti-inflammatory activities. The remarkable features of HPOX are that the polymer degrades completely and one of degradation products is a potent antioxidant. HPOX nanoparticles released HBA which was able to attenuate the production of TNF-α and inhibit the ROS production in activated RAW 264.7 macrophage cells. We anticipate that HPOX is highly potent and versatile for a variety of drug delivery applications due to the remarkable features such as biodegradability, biocompatibility, and anti-inflammatory and antioxidant properties.

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Donghyun Hong obtained his B.S. degree in Polymer×Nano Science and Technology at Chonbuk National University, Korea, in 2010. He is currently a graduate student in the Department of BIN Fusion Technology at the same institute. His research interests are the development of antioxidant biodegradable polymers and their applications for drug delivery and bioimaging.

Gilson Khang is a Professor of Department of Polymer×Nano Science and Technology at Chonbuk National University, Korea. Professor Khang holds a B.S. and M.S. degree from Inha University, Korea, and worked at the Korea Research Institute of Chemistry and Technology (KRICT) until 1991. After receiving his Ph.D. in Biomedical Engineering at the University of Iowa, US, in 1995, he served at KRICT as a Senior Research Scientist before joining the faculty of Polymer×Nano Science and Technology at Chonbuk National University in 1998. His research interests are tissue engineering and regenerative medicine using polymeric scaffolds.

Dongwon Lee is an Assistant Professor in the Department of Polymer×Nano Science and Technology and Department of BIN Fusion Technology at Chonbuk National University, Korea. He obtained his B.S. and M.S. degrees from Yeungnam University, Korea, and his Ph.D. in polymer and biomaterials science at the University of Florida, US, in 2004. He worked at the University of South Florida College of Medicine and Georgia Institute of Technology as a postdoctoral fellow and moved back to Korea to be a faculty of Polymer×Nano Science and Technology in 2008. His research is devoted to the development of biodegradable polymers and multifunctional nanomaterials for bioimaging, drug delivery, and tissue engineering.

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Thermally Induced Coacervation for Altering Drug Release Profiles

Michelle Papp, PhD
Aptalis Pharmaceutical Technologies

Aptalis Pharmaceutical Technologies (formerly Eurand Pharmaceutical Technologies) specializes in product development that leverages our proprietary pharmaceutical technologies. These technologies are utilized to develop novel prescription and OTC products with our partners that are designed to have advantages over existing products and address unmet medical needs. We continue to work with partners to develop and supply our licensed and manufactured products. Integrated R&D and manufacturing teams in the U.S. and Europe support projects from formulation through scale-up and commercial-scale manufacturing. Our track record of commercialization success includes products that are marketed in more than fifty countries around the word by our partners.

Aptalis Pharmaceutical Technologies has multiple customized-release technology platforms for drug delivery suitable for achieving a variety of drug release profiles, including sustained, delayed or pulsatile-release. Examples of technologies within the platform include the *Diffucaps*® technology, which utilizes functional polymer coated multi-particulates; Eurand *Minitabs*®, which are miniature matrix tablets (≤ 2 mm in diameter); *Diffutab*®, which utilizes a conventional matrix tablet to control drug release; and *Microcaps*®, which utilizes a coacervation process to coat drug or drug-containing particles. Of these technologies the latter was the foundation for the evolving expertise pertaining to controlled release technologies; *Microcaps*® has since been developed into a versatile approach for achieving taste-masking, separation of reactive components in a formulation, and for the development of controlled-release profiles.

The *Microcaps*® microencapsulation technology uses coacervation to wrap a particle with a polymeric membrane comprised of polymers such as ethylcellulose, cellulose acetate or gelatin. During coacervation, a solubilized polymer is induced to separate out from solution onto a non-solubilized drug or drug-containing particle in a controlled manner by modifying the physiochemical and thermodynamic properties of the solution. This can be accomplished through the addition of an anti-solvent, a change in pH or by a change in the temperature of the system. Figure 1illustrates thermally induced coacervation. During phase separation, viscous, polymer rich regions are formed that preferentially accumulate at the liquid/particle interface as a result of the reduction in the total free interfacial energy of the system.

Although often used to mask the taste of bitter drugs, customized- release of a drug can be achieved by controlling the coating level of the polymer applied during the microencapsulation process, producing films of consistent adjustable thickness and porosity. In addition, *Microcaps*® can be produced for particle sizes well below 100 microns, providing an advantage over conventional fluid-bed Wurster coating. Given an active pharmaceutical ingredient (API) with a uniform size distribution and shape, the coacervation process can be applied to the primary API particles for sustained release as seen in Figure 2. In cases where the API does not facilitate direct encapsulation because of its physical properties, the drug can be layered onto inert particles such as sugar spheres or cellulose spheres to provide the uniform substrate needed for customized-release applications. Alternatively, suitable drug-containing cores can be produced using other manufacturing techniques, such as extrusion-spheronization and rotogranulation, which afford the flexibility for achieving high drug load substrates. The resultant *Microcaps*® can be incorporated into conventional tablet

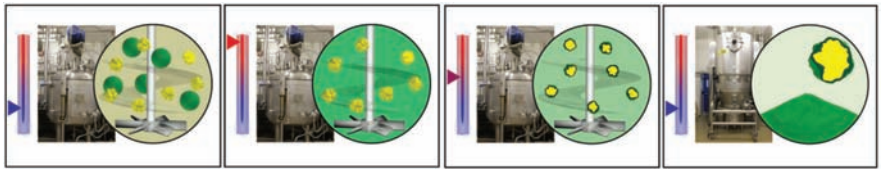

Figure 1. *Initially the API (yellow) is suspended with the polymer (green) in a solvent that the API is not micibile with. As the temperature is increased, the polymer dissolves while the API particles remain suspended. As the temperature is gradually decreased, the polymer undergoes phase separation and will preferentially surround the API particles in solution. The resultant Microcaps® are then dried in a fluid bed, solidifiying the polymeric coating surrounding the API to create a free flowing encapsulated material.*

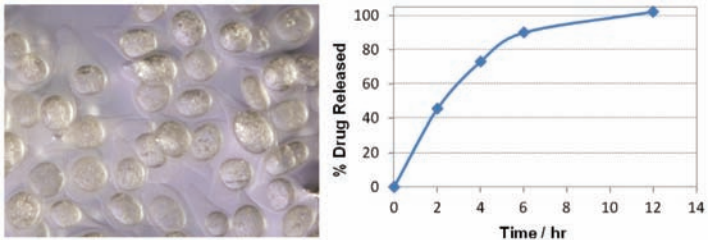

Figure 2. *The image is of a microencapsulated API whereby the primary API particle can be distinguished from the opaque deposited polymeric film. In this example, the uniform particle size and shape of the API facillitated the direct microencapsulation of the API resulting in controlled release over 12 hours.*

Spotlight continued on page 22

Spotlight continued from page 21

formulations, capsules, or orally disintegrating tablets (ODTs), providing additional flexibility in the choice of dosage form.

The application of the *Microcaps*® technology for customized drug release is illustrated in the following example. An ODT formulation for a sparingly soluble, bitter tasting antidepressant was developed, utilizing ethylcellulose as the film-forming polymer at various polymer levels. Because of the needle morphology of the primary drug particles, the API was layered onto 60-80 mesh sugar spheres (approximately 180-250 microns) in a fluid-bed processor and seal coated with hydroxypropyl cellulose, followed by microencapsulation with ethylcellulose at coating levels of 5, 10, and 15 % by weight. The process produced uniformly coated, free flowing beads (Figure 3) suitable for compression into orally disintegrating tablets using *Advatab*® ODT technology. The dissolution profiles of the different ODT formulations were evaluated using a USP II dissolution

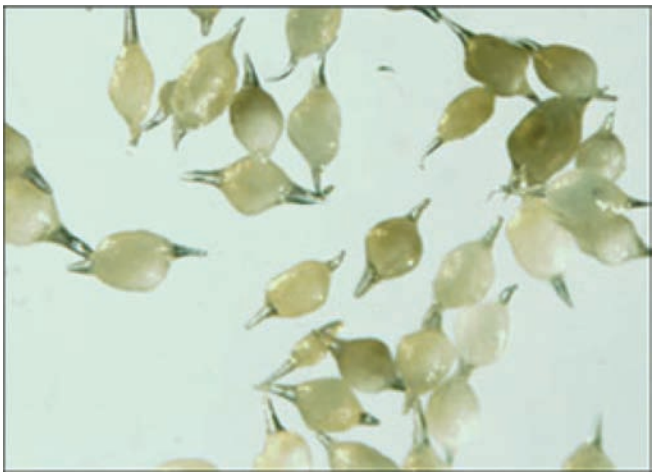

Figure 3. *The drug-containing* Microcaps® *exhibited a uniform particle shape. The polymer 'tails' seen on the* Microcaps® *are a typical characteristic resulting from the coacervation process.*

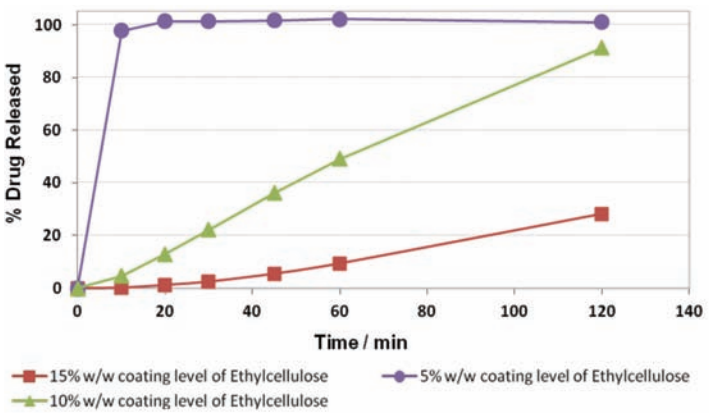

Figure 4. *Various ODT release profiles achieved by varying the coating thickness. Controlled release was achieved with the addition of a 10% coating.*

apparatus. Not only did the polymer film mask the irritation of the API, it likewise provided for the sustained release of the drug beyond two hours when polymer coating levels of 10% or greater were used (Figure 4).

Overall, microencapsulation using a coacervation process can offer a range of release profiles from a variety of API substrates providing flexibility in drug product development. As such it is an important component of the customized-release technology platform of Aptalis Pharmaceutical Technologies, allowing for the optimization of a drug's performance to meet medical and patient needs.

For more information about Aptalis Pharmaceutical Technologies please visit our website at www.AptalisPharmaceuticalTechnologies.com or contact us directly at http://www.aptalispharmaceuticaltechnologies.com/contact.html. ■

Welcome New CRS Members

Ghada Abdelbary
Aly Abdelbary Abdelrahman
Alexis E. Abelow
Mohammad Shahriarul Absar
Vivek Agrahari
Tanira Aguirre
Robert Ahern
Yasuyuki Akiyama
Belal Al Zaitone
Michael Alexandre
Giuliana Piovesan Alves
Lenah Amayreh
Natrah Arifin
Kofi Asare-Addo
Koorosh Ashrafi
Ismail Aslan
Moom Sinn Aw
Oladunni Babasola
Francesca Baldelli Bombelli
James Barlow
Anna Bergstrand
Gahininath Bharate
Amit Bhatia
Tridib Kumar Bhowmick
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Joydeep Biswas
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Nick Boylan
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Gregory Burshtein
Ivan Omar Calderón-Lojero
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Makoto Kataoka
Tatiele Katzer
Navdeep Kaur
Edward Keeley
Helena M. Kelly
Kaoru Kigasawa
Irene Satiko Kikuchi
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Kenichiro Kiyoshima
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Minkyung Ko
Yi-Ju Ko
Masha Kononov
Nalamolu Koteswara Rao
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China Malakondaiah Kummitha
Majella Lane
Mikael Larsson
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Kazuto Watanabe
Preeti Ramesh Wavikar
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Xiaonan Wen
Alexander Wilkinson
John-Michael Williford
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Andrei Winkler
Jing Xu
Qingxing Xu
Shuji Yamashita
Dong Yan
Jun Yang
Jeonga Yang
Yang Yang
Da-Som Yang
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Xianzhu Yang
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Na Young-Guk
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Zhiwen Zhang
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Ming Z. Zhou
Hong Zhuang
Daniel Zucker
John Zupancich

New Jersey Controlled Release Society (NJ-CRS) Chapter Events Update (2010–2011)

Vishwas Rai[1], Sujata Sundara Rajan[1], Robert Falcone[2], and Bozena Michniak-Kohn, Ph.D.[1]

After the formation of the NJ-CRS chapter in May 2008, the chapter has been involved in many scientific meetings and seminars and has co-sponsored poster sessions at several of these events. The chapter was started with the efforts of two individuals—Dr. Bozena Michniak as the faculty advisor and Robert Falcone as its president. In 2008, there were seven members and since then the chapter has grown to about thirty members in 2011. Due to increasing academic and industrial activities, the leadership of the NJ-CRS chapter has increased from two to seven members. Currently, the leadership team consists of Vishwas Rai (President), Sujata Sundara Rajan (President elect for 2011–2012), Tienyuan Wu (Vice-president), Milin Shah (Secretary), Robert Falcone (Treasurer/Chapter advisor), and Dr. Bozena Michniak (Faculty Advisor). Due to the chapter's increasing collaboration with the nearby industries, the chapter added an industrial liaison position that is held by Dr. Claudio Ortiz, a Senior Technical Associate at Colgate Palmolive.

In April 2010, the chapter sponsored two seminars and co-sponsored a workshop along with the New Jersey Center for Biomaterials, The Bioscience Collaborative, and the University of Medicine and Dentistry of New Jersey. The invited seminar speaker was Dr. Philip W. Wertz, Professor at the Department of Oral Pathology at University of Iowa and the Dows Institute, and he spoke about "Lipids and the Permeability Barrier of Skin," covering topics such as "lipids of the stratum corneum and epidermis with emphasis on linoleate-containing species" and "dietary essential fatty acids and their effects on skin and general health." The seminar, which was held at the Life Science Building Auditorium at Rutgers University, NJ, was well-received by an audience of 70 professionals, academics, and students.

In May 2010, the NJ-CRS sponsored the poster session at the annual meeting of the New Jersey American Society Polymer Topical Group seminar titled "Polymers in Drug Delivery" that was held in the Busch Campus Student Center at Rutgers University. A total of 21 posters were presented at the event and were attended by 173 students and professionals from both academia and industry. The winners of the poster competition are listed below:

1st Place: "Bioactive-based Polyanhydride/PVP Physically Cross-linked Hydrogels"

Renata Fogaça, Department of Chemistry and Chemical Biology, Rutgers University, NJ and University of São Paulo, Fundamental Chemistry, São Paulo, SP, Brazil; *Michelle A. Ouimet,* Department of Chemistry and Chemical Biology, Rutgers University, NJ; *Luiz H. Catalani,* University of São Paulo, Fundamental Chemistry, São Paulo, SP, Brazil; and *Kathryn E. Uhrich,* Department of Chemistry and Chemical Biology, Rutgers University, NJ.

2nd Place: "Harnessing the Therapeutic Potential of Functionalized Nanoscale Amphiphilic Macromolecules: From Delivery Vehicles to Polymeric Ligands"

Sarah M. Sparks, Department of Chemistry and Chemical Biology, Rutgers University, NJ; *Nicole Iverson,* Department of Biomedical Engineering, Rutgers University, NJ; *Nicole M. Plourde,* Department of Chemical and Biochemical Engineering, Rutgers University, NJ; *Carolyn L. Waite,* Department of Chemical and Biochemical Engineering, Rutgers University, NJ; *Alex M. Harmon,* Department of Chemistry and Chemical Biology, Rutgers University, NJ; *Charles M. Roth,* Department of Biomedical Engineering and Department of Chemical and Biochemical Engineering, Rutgers University, NJ; *Prabhas V. Moghe,* Department of Biomedical Engineering and Department of Chemical and Biochemical Engineering, Rutgers University, NJ; and *Kathryn E. Uhrich,* Department of Chemistry and Chemical Biology and Department of Biomedical Engineering, Rutgers University, NJ.

3rd Place: "Fusion in Phase-Separated Lipid Membranes – Dependance on pH and Cholesterol"

Manali Bhagat, Department of Chemical and Biological Engineering, Polytechnic Institute of New York University, Brooklyn, NY; and *Stavroula Sofou,* Department of Chemical and Biological Engineering, Polytechnic Institute of New York University, Brooklyn, NY.

On October 22nd, 2010, the NJ-CRS sponsored the poster competition during the "Third Annual Skin Workshop" of the Center for Dermal Research, an event sponsored by the AAPS Rutgers Student Chapter, the University of Medicine and Dentistry of New Jersey, the New Jersey Center of Biomaterials, and the Rutgers School of Pharmacy. The meeting was held at the Rutgers Life Science Building, Busch Campus, and was attended by more than 60 industry and academic professionals. The workshop featured three prominent speakers: Priya Batheja, Ph.D. (Capsugel, Boston, MA), Nava Dayan, Ph.D. (Lipo Chemicals, Paterson, NJ), and Richard Mendelsohn, Ph.D. (Rutgers University, Newark, NJ).

[1] Ernest Mario School of Pharmacy, Rutgers – The State University of New Jersey.
[2] Medical Device Concept Laboratory, New Jersey Institute of Technology, Newark, NJ.

The keynote speakers for the conference included Drs. Neal Walker and Stuart Shanler of Vicept Therapeutics, who discussed their experience in reformulating oxymetazoline hydrochloride (Afrin) as a topical therapy for patients with rosacea. CRS members from all chapters were invited and were given discounted admission to the conference. Three cash prizes were awarded to the winners of the poster competition.

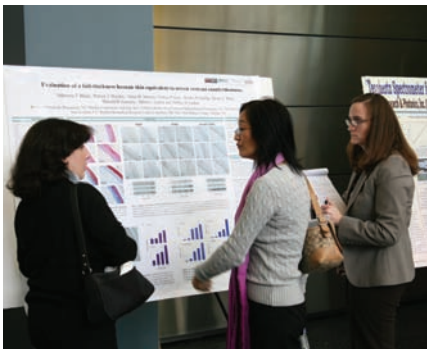
Poster viewers at the Skin Workshop Poster Session sponsored by NJ-CRS.

The winners are listed below:

1st Prize: "Paclitaxel-Loaded Tyrospheres for the Treatment of Psoriasis – *In Vitro* Studies" *Brian E. Kilfoyle,* Department of Pharmaceutics, Rutgers University, NJ.

2nd Prize: "Evaluation of full thickness human skin equivalent to screen vesicant countermeasures" *Adrienne T. Black,* Rutgers University, Piscataway, NJ.

Plaque awarded to winner of poster competition.



Adrienne Black explaining her poster to the attendees.

3rd Prize: "Monitoring the Viscoelastic Properties of Skin in Liquid Environment Using Quartz Crystal Microbalance" *N. Sanjeeva Murthy,* New Jersey Center for Biomaterials.

The year end for the NJ-CRS community was marked by a get-together dinner, and celebration of successful efforts of the team during the year and plans were made for the forthcoming year 2011.

Future Events

The current leadership has continued their efforts to attract new members to the NJ CRS community. We are also in the process of setting up a "Topical Discussion Group" that will consist of members from industry, academia, and government that will promote discussion on emerging topics in the area of controlled delivery technologies. The upcoming NJ-CRS events will be announced to the CRS community via e-mail.

NJ-CRS end of the year celebration.

For more information about the activities and membership of NJ-CRS, please contact Christine Otto at cbmfrontdesk@biology.rutgers.edu. ■

UKICRS 2011 Annual Meeting – 13th April 2011
Postgraduate Symposium at Queens University, Belfast

Jitinder Wilkhu, Sagida Bibi, Behfar Moghaddam, Sarah McNeil, and Alex Wilkinson
Aston School of Pharmacy, Aston University

The UK and Ireland Controlled Release Society was proud to announce that the venue for the 2011 meeting was to be held at Queens University in Belfast, Ireland – it had been eight years since we had last been to the friendly city of Belfast. The conference was held in the Victorian splendor of the Lanyon Building's "Great Hall," which was restored in 2002 at a cost of £2.5 million and provided a prestigious backdrop for this year's meeting.

Opening the meeting, Professor Vladimir Torchilin, from Northeastern University, presented a talk on pharmaceutical nanotechnology in drug delivery. Vladimir is one of the world's leading researchers in this field, as displayed by his vast array of publications in this field. His talk focused on the use of multifunctional pharmaceutical nanocarriers, mainly liposomes and polymeric micelles, for targeted delivery of imaging agents, drugs, and genes in cancer and cardiovascular diseases. In addition, the delivery of siRNA and DNA-loaded nanoparticles with the use of polyethylene glycol (PEG), copolymers, and penetrating peptides were discussed. Following on from Professor Torchilin was the first postgraduate speaker of the day, Robyn Fowler, from the University of Nottingham, UK. This presentation provided an insight on the use of Caco2 and Calu3 cells as *in vitro* models of the airway and intestinal epithelia, respectively, in order to compare their morphological and barrier-like properties in the field of drug discovery research. Generally, the two cell lines were shown to differ in their properties, with Caco2 showing a greater level of macromolecular permeability of dextrans due to the larger surface area of the tight junctions in this model of the intestinal epithelium.

Some of the UKICRS delegates outside the Conference venue.

Prof. Vladimir Torchilin with UKICRS committee members (from left to right) Vitaliy Khutoryanskiy, Yvonne Perrie, Gavin Andrews, and Karl Malcolm.

Straight after the coffee break it was time for the second postgraduate speaker, Jitinder Singh Wilkhu, from Aston University, Birmingham, UK, where the emphasis of the talk was based on the use of differential scanning calorimetry (DSC) to understand thermal properties of surfactants used in the formulation of bilayer vesicles. The talk investigated how techniques such as thermogravimetric analysis and DSC may be used to understand the melting of surfactants and how such temperature can be modified to produce vesicles. The postgraduate talks continued with a presentation from Maha Nasr from the University of Central Lancashire who introduced an "alternative route of administration for biophosphonates: from theory to practice." The talk provided an overview of all the techniques used in optimizing the encapsulation of a model biophosphonate into microspheres. The results indicated the safety profile of the microspheres and deemed them to be safe to deliver to the lungs; by being biodegradable, it opens the doorway of many drugs to be delivered largescale via this method. The final talk of the morning session was from the home team, Queen's, and was based on novel silicone elastomer gels for sustained vaginal delivery of HIV-1 entry inhibitor, Maraviroc. This interesting oral presentation considered the use of novel gels to overcome existing problems with poor solubilization of microbicide candidates and degradation by vaginal fluids. The data showed promising results, especially in terms of drug concentrations measured in blood and vaginal fluid compared to existing gels. Perhaps the most memorable aspect of the talk was the slug mucosal irritation test... preparing us nicely for lunch!

During the poster session we had around 60 posters presented and the judging of the posters was by peer review; each delegate had a "star" that they were asked to place beside the poster they felt was the best – the winners of the poster session were the two posters with the most stars.

Karl Malcolm opens the day and welcomes everyone to Queen's University Belfast.

After returning from lunch fully energized, the afternoon session was opened by the second invited speaker of the day, Professor Morgan Alexander from the University of Nottingham. Professor Alexander highlighted the importance of surfaces and their interactions with biological materials and gave us a glimpse into the future of new polymers, and the important role they can play in maintaining stem cell cultures. Robert Ahren, from University College Cork, then presented data on investigation into the effect of processing conditions on fenofibrate dissolution rate. The objective of the research was to increase the dissolution rate of fenofibrate by loading it onto a high-surface area carrier, which was mesoporous silica, with his results showing that there is a considerable enhancement of drug dissolution rate in all processed systems. Amr ElShaer from Aston University, Birmingham then presented, "Could amino acid salts fool fussy bacteria to improve antibiotics uptake?" The results showed that the new salts were equally effective as the basic drug in terms of drug action and solubility studies demonstrated that the novel salts improved the solubility of trimethoprim by 250 fold. Further investigations included whether intrinsic resistant bacteria would take up amino acid salts and in turn improve the uptake of TMP. Wei Chen (Queen's University, Belfast), then discussed a novel bacterial protease-triggered polymeric antimicrobial release system. The aim of this research was to develop novel hydrogel device coating where antimicrobial release is triggered by bacterial proteases such as *S. aureus* V8 protease. This study revealed that this aim can be achievable and may offer an approach to reduce device associated biofilm formation.

The final session of the conference was opened by Marija Bezbradica from Dublin City University, Ireland, with a presentation entitled "Ethylcellulose/pectin coated microspheres in controlled drug delivery: Agent based modelling." This work demonstrated the application of an agent-based modeling system for testing the dissolution of drugs from coated microspheres, which can be used in order to test and mimic experimental conditions and outcomes. Following this, Dr. Sarah McNeil (Aston University, Birmingham) presented "Formulation and *in vitro* assessment of liposomal DNA vaccines," where she highlighted the application of a design of experiments package to extensively investigate the determining parameters of liposomal-DNA vaccines for effective transfection *in vitro*. By inputting various factors and variables and subsequently defining the output responses, design of experiments (DoE) selectively generates a random list of experimental tests to be carried out enabling greater precision at estimating the overall main factors which may affect liposomal characteristics and DNA transfection, while significantly reducing experimental costs. The final presentation of the conference was presented by Martin Garland (Queen's University), who gave a comprehensive

Photos from the day.

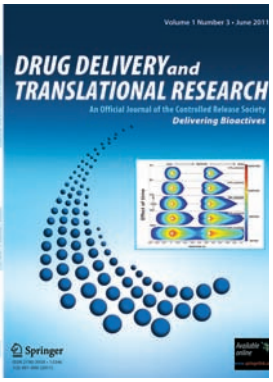
overview of the "Clinical evaluation of a polymeric microneedle array for transdermal drug delivery applications." The application of microneedles for the delivery of drugs across the skin is highly dependent on the perception and amount of pain the microneedles impose on the patient. The clinical study revealed that hydrogel microneedles were minimally invasive, causing minimal and shorted lived skin irritation, demonstrating the potential application of hydrogel microneedles as a safe device for transdermal drug delivery.

Rounding off the day, the two poster prize winners were announced. As voted by the attendees, the happy recipients of the UKICRS 2011 poster prizes were Giles Kirby from Nottingham University with a poster on "PLGA-based microparticles for the sustained repease of BMP-2" and TM Tuan-Mahmood from Queen's University Belfast with a poster on "Soluble polymeric microneedle-mediated transdermal delivery of caffeine and lidocaine for paediatric application: comparison of three *in vitro* models." Overall, Queen's University Belfast proved to be a great place to host the 2011 annual conference with a splendid atmosphere. The delegates were all left smiling and eagerly anticipate what the 2012 conference will hold.

For more information on UKICRS please visit http://www.ukicrs.org/ or follow us on Facebook. ■

DDTR Special Focus Issue on "Advances in Vaginal Drug Delivery"

Guest Editor: David R. Friend, CONRAD, Arlington, VA 22209, U.S.A.; dfriend@conrad.org



Vaginal Drug Delivery and Reproductive Health

Sexually transmitted infections (STIs) remain a significant problem, both in developed and developing world settings. According to statistics from UNAIDS/WHO, 33.3 million people are living with HIV-1 infection, with 2.6 million new infections in 2009. In addition, the WHO estimated 340 million new cases of gonorrhea, chlamydia, syphilis, and trichomoniasis throughout the world in 1999, in both men and women aged 15–49 years. HSV-2 is the most common cause of genital warts and is highly prevalent among sexually active individuals. Seroprevalence rates of HSV-2 range from 22% of sexually active adults in the USA to up to 60% in HIV-negative women in sub-Saharan Africa and men who have sex with men (MSM) in Latin America. Additionally, more than 80% of individuals infected with HIV-1 are also infected with HSV-2. Unplanned pregnancies in both the developed and developing world remain a significant problem.

STIs and pregnancy are two drivers in the development of new vaginal drug delivery systems. Among STIs, prevention of HIV-1 transmission has been a funding priority for the National Institutes of Allergy and Infectious Diseases (NIAID), the United States Agency for International Development (USAID), and the Bill and Melinda Gates Foundation. Early attempts to prevent transmission of HIV-1 from men to woman were based on the use of surfactants, polyanions, and acid buffers. Unfortunately, these compounds failed to protect women against HIV-1 infection.

However, a recently completed Phase 2b study (CAPRISA-004) in South African women examining the nucleotide reverse transcriptase inhibitor tenofovir in a vaginal gel (microbicide) demonstrated a significant reduction in HIV-1 transmission. The dosing regimen involved administering the gel within 12 hours of coitus followed by second dose within the next 12 hours. Another study is currently ongoing in sub-Saharan Africa, called VOICE, to investigate once daily dosing of the same gel. A Phase 3 trial, designed as a confirmatory trial of CAPRISA-004, is about to begin in South Africa.

Another Phase 3 trial is scheduled to start soon using a novel intravaginal ring (IVR) product capable of delivering the non-nucleotide reverse transcriptase inhibitor dapivirine over a 28-day duration. This type of delivery system has potential advantages over daily or peri-coital dosing in terms of adherence to use.

Many other microbicide products are being evaluated in IVRs, fast dissolve films, and fast dissolve tablets. As in treatment of HIV-1 infection, combination products for vaginal delivery are also in development. Combinations are being investigated to treat two different indications such as prevention of HIV-1 infection and contraception.

Both novel and traditional vaginal delivery systems will play an increasing role as the field of female reproductive health expands. In this special issue, read articles on current gaps in the development of topical vaginal microbicide products, recent advances in intravaginal rings (including a late stage product that releases dapivirne, a novel nonnucleoside reverse transcriptase inhibitor [NNRTI]), fast dissolve vaginal tablets, and novel vaginal formulations capable of delivering nitric oxide. The issue also includes articles on specific intravaginal ring formulations, including biodegradable rings, for the local delivery of the NNRTI UC781. New models for potentially predicting performance of vaginal products are also reviewed.

View Advances in Vaginal Drug Delivery, by David Friend, in Drug Delivery and Translational Research, Volume 1, Number 3 / June 2011, Pages 183-276.

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CRS and Springer Will Combine to Reward *DDTR* Outstanding Paper Recipient

The scientist who receives the *DDTR* Outstanding Paper Award will receive recognition from the Society along with valuable prizes from Springer publishing and CRS, according to *DDTR* Editor-in-Chief, Vinod Labhasetwar. Chosen from *DDTR* authors, the awardee will receive the following:

- $500 Book Award – Choice of more than 37,000 titles published by Springer
- Complimentary CRS Annual Meeting and Exposition Registration
- Certificate of Recognition
- Award Winner to Give Presentation at the 39th CRS Annual Meeting

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Upcoming Special Issues

A *DDTR* Special Focus Issue on "Advances in Image-Guided Drug Delivery" with Arash Hatefi and Tamara Minko from Rutgers, The State University of New Jersey, as Guest Editors

Image-guided drug delivery (IGDD) is an emerging therapeutic approach where imaging modalities are used to guide and monitor localization of therapeutics to the site of action. Therefore, a methodical approach to IGDD entails systems for delivery, targeting, and monitoring (imaging) of the course of action. This special issue will cover various technologies that are being developed for simultaneous drug delivery validation and therapeutic response evaluation in disease conditions.

A *DDTR* Special Focus Issue on "CNS Drug Delivery of Biologics," with Pericles Calias, Senior Director, Nonclinical Development, Shire HGT, as Guest Editor

Strategies for treating the Central Nervous System (CNS) manifestations of diseases have evolved well beyond the traditional size/lipophilicity paradigm. This special issue describes the challenges of developing therapies targeted to the CNS, from bench to clinical development. A review of the biological hurdles and current strategies for overcoming them will set the stage for discussions on the assessment of the product's pharmacologic effect within the CNS and regulatory considerations for the incorporation of biomarkers into product development programs. ■

David Friend is Director of Product Development and Associate Research Professor at CONRAD, a division of the Ob-Gyn Department of Eastern Virginia Medical School. His current research and development interests cover all aspects of preclinical development to clinical manufacturing of novel vaginal products. These products are capable of preventing transmission of HIV to women living in the developing world. Dosage forms under development in gels, intravaginal rings, and fast dissolve tablets. oduct Development and Associate Research Professor at CONRAD, a division of the Ob-Gyn Department of Eastern Virginia Medical School. His current research and development interests cover all aspects of preclinical development to clinical manufacturing of novel vaginal products. These products are capable of preventing transmission of HIV to women living in the developing world. Dosage forms under development in gels, intravaginal rings, and fast dissolve tablets.

DDTR Most Read Articles

View what your colleagues are reading in *DDTR* (top 5 articles as of May 9, 2011):

- **Convection-enhanced delivery of camptothecin-loaded polymer nanoparticles for treatment of intracranial tumors.** Sawyer, Andrew J.; Saucier-Sawyer, Jennifer K.; Booth, Carmen J.; Liu, Jie; Patel, Toral; Piepmeier, Joseph M.; and Saltzman, W. Mark.
- **Novel antigen delivery technologies: a review.** Jain, Deepika; Jain, Vikas; and Singh, Ranjit.
- **Nanofibrous scaffold with incorporated protein gradient for directing neurite outgrowth.** Handarmin; Tan, Geneca Joo Yi; Sundaray, Bibekananda; Marcy, Guillaume Thierry; Goh, Eyleen Lay Keow; and Chew, Sing Yian.
- **Phospholipid–polyethylenimine conjugate-based micelle-like nanoparticles for siRNA delivery.** Navarro, Gemma; Sawant, Rupa R.; Essex, Sean; Tros de ILarduya, Conchita; and Torchilin, Vladimir P.
- **Liposomes as multicompartmental carriers for multidrug delivery in anticancer chemotherapy.** Cosco, Donato; Paolino, Donatella; Maiuolo, Jessica; Russo, Diego; and Fresta, Massimo.

Journal of Controlled Release Top 10 Cited Articles

Want to know the research that is changing delivery science? Below is a listing of the top 10 cited articles from the *Journal of Controlled Release* from the past five years. Extracted from Scopus on April 28, 2011.

- **Polyionic hydrocolloids for the intestinal delivery of protein drugs: Alginate and chitosan – a review.** Volume 114, Issue 1, 2006, pp. 1–14. George, M.; and Abraham, T. E.
- **Toxicity of cationic lipids and cationic polymers in gene delivery.** Volume 114, Issue 1, 2006, pp. 100–109. Lv, H.; Zhang, S.; Wang, B.; Cui, S.; and Yan, J.
- **PEG-modified gold nanorods with a stealth character for *in vivo* applications.** Volume 114, Issue 3, 2006, pp. 343–347. Niidome, T.; Yamagata, M.; Okamoto, Y.; Akiyama, Y.; Takahashi, H.; Kawano, T.; Katayama, Y.; and Niidome, Y.
- **A review of stimuli-responsive nanocarriers for drug and gene delivery.** Volume 126, Issue 3, 2008, pp. 187–204. Ganta, S.; Devalapally, H.; Shahiwala, A.; and Amiji, M.
- **Nanoparticles as potential oral delivery systems of proteins and vaccines: A mechanistic approach.** Volume 116, Issue 1, 2006, pp. 1–27. des Rieux, A.; Fievez, V.; Garinot, M.; Schneider, Y.-J.; and Préat, V.
- **Nano/micro technologies for delivering macromolecular therapeutics using poly(d,l-lactide-co-glycolide) and its derivatives.** Volume 125, Issue 3, 2008, pp. 193–209. Mundargi, R. C.; Babu, V. R.; Rangaswamy, V.; Patel, P.; and Aminabhavi, T. M.
- **Cationic lipids, lipoplexes and intracellular delivery of genes.** Volume 116, Issue 2 SPEC. ISS., 2006, pp. 255–264. Wasungu, L.; and Hoekstra, D.
- **Polysaccharide hydrogels for modified release formulations.** Volume 119, Issue 1, 2007, pp. 5–24. Coviello, T.; Matricardi, P.; Marianecci, C.; and Alhaique, F.
- **Role of antioxidants in prophylaxis and therapy: A pharmaceutical perspective.** Volume 113, Issue 3, 2006, pp. 189–207. Ratnam, D. V.; Ankola, D. D.; Bhardwaj, V.; Sahana, D. K.; and Kumar, M. N. V. R.
- ***In situ* gelling stimuli-sensitive block copolymer hydrogels for drug delivery.** Volume 127, Issue 3, 2008, pp. 189–207. He, C.; Kim, S. W.; and Lee, D. S. ■

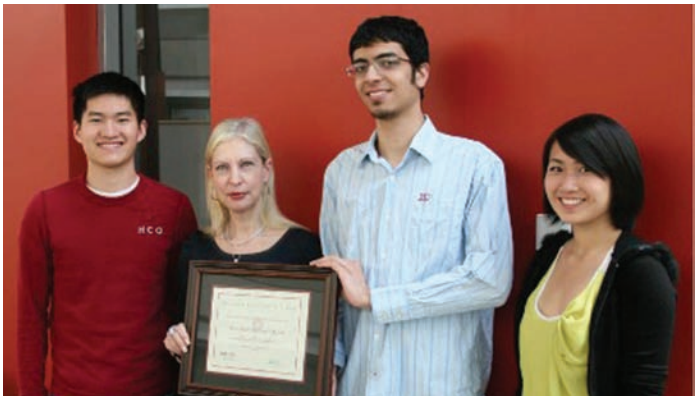
People in the News

Compiled by Steven Giannos
Industrial Editor

Prof. Michniak-Kohn is Aresty Faculty Mentor of the Year 2011

Dr. Bozena Michniak-Kohn was named the Aresty Faculty Mentor of the Year at the Rutgers University 7th Aresty Undergraduate Research Symposium, April 29th, 2011.

Three students from the Michniak research group presented their work. Yang "Mimi" Chen, an Ernest Mario School of Pharmacy undergraduate student, had a podium session entitled "Topical treatment of psoriasis using tyrosine-derived nanospheres." Michael Chiou, a School of Arts and Sciences student majoring in Biological Sciences Economics, and Ali Hady, a School of Arts and Sciences student majoring in Cell Biology and Neuroscience, presented posters "Permeation of nicotine across Polyderm human skin equivalent" (nominated for Best Poster Award) and "Development of a human skin equivalent to screen the percutaneous permeability of compounds," respectively.



Pictured Left to Right: Michael Chiou, Dr. Michniak, Ali Hady, and Yang Chen.

Since the 1970s, Jerome (Rutgers College Class of 1951) and Lorraine Aresty made extraordinary contributions to many of Rutgers's programs and facilities. In 2004, Mr. and Mrs. Aresty shared with Rutgers a vision for a program that might coordinate and improve upon the support structure for undergraduate research, and the Aresty Research Center for Undergraduates (ARC) was born. The generosity of Jerome and Lorraine Aresty helps some of Rutgers's most talented students use the strong scholarly foundation acquired during their undergraduate years to establish themselves as mature and independent thinkers and scholars.

Inaugural Launch of the Center for Dermal Research at Rutgers University on March 3, 2011

Organized by Professor Bozena Michniak-Kohn, Department of Pharmaceutics at the Ernest Mario School of Pharmacy, the inaugural launch of the Center for Dermal Research (CDR) at Rutgers University was held on March 3, 2011. The CDR is co-sponsored by the NJ Center for Biomaterials, the NJ Controlled Release Student Chapter, and co-hosted by the Bioscience Collaborative and UMDNJ RWJ Medical School.

The Center for Dermal Research is the premier dermatopharmaceutics research center in NJ, conducting studies on topical and transdermal compound delivery, skin biology, and skin tissue engineering. The CDR will also provide quality educational opportunities for its members through workshops, seminar series, symposia, and courses. Upcoming seminar dates and speakers as well as archived presentations for those unable to attend can be found online at http://www.centerfordermal research.org/.

The Center for Dermal Research provides opportunities for research interactions with the Laboratory for Drug Delivery (LDD) at Rutgers (directed by Prof. Michniak-Kohn) as well as with the research groups of CDR Participating Faculty & Collaborators. The Michniak LDD research group conducts studies on topical and transdermal as well as buccal compound delivery, skin biology, novel drug carriers, and tissue engineering of skin.

The major challenge in skin research is overcoming the natural resistance of the skin to compound permeation particularly for larger molecular weight drugs due to its highly developed barrier properties. Research within the LDD will improve the design of therapeutically effective topical and transdermal formulations and find non-damaging solutions to overcoming the skin's permeation barrier. The LDD also explores topicals and cosmeceuticals with controlled and targeted delivery of actives to skin layers while preventing fast transport into the systemic circulation. In contrast, for transdermal delivery we need fast transport across all skin layers, little drug retention in the skin, and adequate clinical pharmacokinetics for the patient receiving the transdermal patch treatment.

Developing new tissue engineered skin substitutes for permeability testing of actives and for optimization of topical and transdermal formulations are additional goals of the LDD. Several projects involve tissue engineered full-thickness human skin models that have been shown to adequately predict drug permeability in human skin. Studies include evaluation of correlations between the drug permeability, stratum corneum lipid composition/organization, growth media composition, immunohistochemistry, and morphology and gross structure of the bioengineered skins. In addition, novel polymer dermal scaffolds are being tested in the model to improve its mechanical strength. Additional investigations involve the effects of protective barrier creams and other formulations on the penetration of chemical warfare agent mimics, insecticides, personal care, and cosmetic actives using the skin models. ■

In the News

Compiled by Steven Giannos
Industrial Editor

May 2011

Micell Technologies Reports Preclinical Data for MiStent™ Drug-Eluting Coronary Stent to be Presented at EuroPCR

PRNewswire: May 11, 2011 – DURHAM, NC – Micell Technologies, Inc. today announced that positive preclinical data will be presented at the EuroPCR conference in Paris, France on May 18, 2011 in a presentation titled, "MiStent DES: A Novel Third Generation DES with a Fully-Absorbable Coating and Enhanced Drug Delivery Capabilities." The MiStent Drug-Eluting Coronary Stent System ("MiStent DES") is an ultra-thin, advanced alloy drug-eluting stent distinguished by a rapid-absorbing drug/polymer coating formulation.

In a porcine coronary model, data show continuous and controlled release of sirolimus, with the MiStent DES coating being eliminated from the stent within 45 to 60 days, and fully absorbed in the tissue by 90 days following implant. Preclinical studies additionally demonstrated a positive indication of safety with lower inflammation observed from the MiStent DES compared to the bare metal Abbott MULTI-LINK Vision™ Coronary Stent at 30 and 90 days in the challenging overlapping stents implant configuration.

James B. McClain, Ph.D., Senior Vice President of Micell, said, "Micell is uniting well-known DES stent components with a proprietary coating process to produce a fundamentally different DES. Our preclinical studies demonstrate a markedly consistent drug delivery profile with controlled, linear release of therapeutic levels of drug."

Clinical trials of the MiStent DES include DESSOLVE I, a study of 30 patients with documented stable or unstable angina pectoris or ischemia, which completed enrollment earlier this year. The primary endpoint is in-stent late lumen loss, as measured with angiography in treated *de novo* lesions ranging in diameter from 2.5 to 3.5 mm and amenable to treatment with a maximum 23 mm long stent. DESSOLVE II is an ongoing multi-center study of approximately 270 patients with documented stable or unstable angina pectoris or ischemia. The primary endpoint is superiority of MiStent DES in minimizing in-stent late lumen loss at nine months, compared to Medtronic's Endeavor® Sprint DES, as measured with angiography in treated *de novo* lesions ranging in diameter from 2.5 to 3.5 mm and amenable to treatment with a maximum 30 mm long stent.

Elazer R. Edelman, M.D., Ph.D., commented, "The presented data, based on a thorough preclinical evaluation, validate the premise that Micell's unique coating process could produce a remarkable level of consistency and control in a drug-eluting stent." Dr. Edelman is the Thomas D. and Virginia W. Cabot Professor of Health Sciences and Technology at the Massachusetts Institute of Technology and is a consultant to Micell.

Alkermes to Merge with Elan Drug Technologies to Create Alkermes plc

Business Wire: May 9, 2011 – WALTHAM, MA & DUBLIN, IRELAND – Alkermes, Inc. (NASDAQ: ALKS) and Elan Corporation, plc (NYSE: ELN) today announced the execution of a definitive agreement under which Alkermes will merge with Elan Drug Technologies (EDT), the profitable, world-class drug formulation and manufacturing business unit of Elan, in a cash and stock transaction currently valued at approximately $960 million. Alkermes and EDT will be combined under a new holding company incorporated in Ireland. This newly created company will be named Alkermes plc.

The transaction is expected to be immediately accretive to cash earnings and accelerates Alkermes' path to building a sustainably profitable biopharmaceutical company with expertise in developing treatments for central nervous system (CNS) diseases and a broad, diversified portfolio of products and pipeline based on proprietary science and technologies. Alkermes plc will have diverse revenue streams from 25 commercialized products, with future near-term growth expected to be driven by five major products: RISPERDAL® CONSTA®, INVEGA® SUSTENNA®, AMPYRA®, VIVITROL®, and BYDUREON™. The combined company is expected to have growing product, royalty, and manufacturing revenues in excess of $450 million annually and resources to prudently invest in an innovative pipeline of proprietary drugs.

"The merger will be financially transformative and create a profitable, global biopharmaceutical company with a diversified CNS product portfolio and a strong foundation for growth," stated Richard Pops, Chief Executive Officer of Alkermes. "Both companies have a proven track record as innovators. This merger will bring the scale and resources for strategic and balanced investment across the whole product continuum, from R&D innovation to clinical development, to world-class manufacturing and commercial expansion. We're looking forward to working with the EDT team to accelerate growth and to create value for our shareholders and the patients we serve."

Kelly Martin, Chief Executive Officer of Elan plc, commented that, "upon closing, this transaction aggressively advances a number of long-standing strategic and financial objectives for Elan. Namely, it enables us to reduce the debt on our balance sheet and further improve our capital structure, increases operating leverage, allows for additional focus and continued disciplined investment in a broad array of opportunities within the neurology space from a scientific, clinical and product point of view and lastly, provides Elan shareholders with the

opportunity to realize further value – over time – from the equity position in Alkermes plc."

"The combination of Alkermes and EDT is a strong strategic fit at the right time when both businesses are strong and positioned for growth. With EDT's two recently approved drugs, INVEGA SUSTENNA and AMPYRA, driving revenue growth, the EDT business is an ideal complement to Alkermes' portfolio of approved and development-stage drugs," stated Shane Cooke, Executive Vice President and Head of EDT. "This combination creates opportunities for our employees and provides a platform for future growth."

Pearl Therapeutics Highlights its Porous Particle Cosuspension Platform, Demonstrating Universal Applicability Across Multiple Drug Classes and Combination Products

PRNewswire: May 5, 2011 – REDWOOD CITY, CA – Pearl Therapeutics Inc. made three presentations at the Respiratory Drug Delivery Europe (RDD Europe 2011) meeting in Berlin this week elucidating the tunability, versatility, and universality of the Company's porous particle-based metered dose inhaler (MDI) development approach. The data provides details of Pearl's products and novel cosuspension platform, which facilitates forming stable MDI suspensions containing respiratory drugs as single components at various doses, various dual combinations, and a highly uniform triple drug combination. Further, Pearl's technology accommodates drugs of different pharmacological and chemical classes and uses conventional manufacturing processes for clinical and commercial scale production.

"Pearl scientists have developed a novel and unique cosuspension formulation approach that allows different respiratory medicines and their combinations to be formulated readily, and delivered efficiently, with the simple press-and-breathe MDI dosage form," commented Sarvajna Dwivedi, Ph.D., executive vice president and cofounder of Pearl Therapeutics. "Utilizing commercially available MDI components and manufacturing equipment, we have rapidly progressed two highly potent bronchodilators, both alone and as a dual combination product, into Phase 2b development, while successfully formulating a triple drug combination in parallel, with extensive proof of stability for each product. Our progress and results show that the cosuspension platform has the potential of formulating drug products for improved predictability of clinical development, enhanced patient experience and compliance across therapy types, and reduced development and manufacturing costs."

In his oral presentation, Dr. Dwivedi described the physicochemical characteristics of Pearl's cosuspension platform that allows MDIs – currently used to deliver over 70% of the inhaled doses worldwide – to be developed with long-acting muscarinic antagonists (LAMA), long-acting beta-2 adrenergic receptor agonists (LABA), and inhaled corticosteroids (ICS), in their natural crystalline form. The evidence showed that the porous particles are practically insoluble in hydrofluoroalkane (HFA) propellant, and associate with micronized drug crystals in a way that reduces the interaction between crystals and with the inhaler components.

A supporting poster provided a comparison of dual and triple cosuspensions of the potent LAMA, glycopyrrolate with either the highly potent LABA, formoterol fumarate, or the ICS, mometasone furoate, or both formoterol fumarate and mometasone furoate. Pearl's porous particle cosuspensions, whether formed with one, two, or three of these drugs, generate highly efficient aerosols with equivalent aerodynamic particle size distribution. Moreover, they maintain long-term chemical stability within internationally accepted limits for each drug after months of storage at room temperature, confirming the continuity of product performance across various product types with Pearl's cosuspension platform over time.

Additionally, Pearl presented evidence that the cosuspensions form quickly and can be manufactured by pressure filling into MDIs using commercially available filling equipment and standard MDI components. Various doses of single, dual, and triple combination cosuspensions were produced at small scale with a process representative of commercial scale, and were found to be stable with dose-proportional and uniform aerodynamic size distribution profiles.

Dr. Dwivedi added, "The Pearl cosuspension offers consistently efficient drug delivery across drug classes, doses and product types; no detrimental physical or chemical interaction between drugs or between drugs and inhaler components over long periods of time; and manufacturability with standard components and equipment. These attributes finally position MDIs to be the simple and universal dosage form that they were designed to be when first introduced over 50 years ago."

"The Pearl cosuspension platform's predictability of drug delivery across various therapeutic classes and product types, and compatibility with conventional manufacturing equipment, should allow product development and commercial-scale production to proceed without loss of time due to complicated iterative development that has traditionally plagued inhalation product development, and without costly investment in new capital equipment or processes. We expect that this will yield significant timeline and economic advantages to Pearl, as well as to potential partners," said Chuck Bramlage, Pearl's chief executive officer.

RDD Europe took place from May 3–6, 2011, in Berlin, Germany. Information regarding RDD Europe may be found on the congress website at www.rddonline.com.

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In the News continued from page 33

Novozymes Biopharma Collaborates with the University of Oslo to Develop Enhanced Albumin Fusion Technology that Tailors the Half-Life of Proteins

May 5, 2011 – NOTTINGHAM, UK – Novozymes Biopharma, part of Novozymes A/S, the world leader in bio-innovation, today unveiled its enhanced next-generation albumin technology, which was developed in collaboration with the University of Oslo, Norway, one of the world's leading institutions in the research of albumin variants and the neonatal Fc receptor (FcRn). Built on Novozymes' original albufuse platform, the proprietary Albufuse Flex technology has been designed to enable users to adapt and control the pharmacokinetics of their target protein or peptide with retained efficacy, ensuring flexibility and optimal use.

"Novozymes Biopharma is thrilled to introduce Albufuse Flex to the industry," says Dave Mead, Business Development Director at Novozymes Biopharma. "Albumin is a natural and benign carrier molecule, and by having the unique ability to decrease or increase its half-life it will help our customers to develop novel drugs with improved pharmacokinetic properties for a wide range of applications."

It has been shown that by manipulating the interaction of albumin and IgGs with FcRn, it is possible to tailor their half-life. The Albufuse Flextechnology has been developed to facilitate manipulation based on this FcRn-albumin interaction, enabling a tunable half-life that offers control and flexibility and that, potentially, may improve overall treatment efficacy and patient compliance. In addition to protein- or peptide-based drugs, the enhanced technology also provides a delivery vehicle for small molecules, providing a broad scope of usability.

The enhanced half-life technology has been developed by Novozymes in collaboration with scientists at the University of Oslo. The innovative research developed by the university into the interaction between albumin variants and the neonatal Fc receptor (FcRn) was fundamental in the development of Albufuse Flex.

Professor Inger Sandlie, group leader at the Norwegian Centre of Excellence for Immune Regulation, says: "The efficacy of peptides, small proteins, and engineered antibody fragments is hampered by short serum half-life. Therefore, strategies to tailor their serum persistence and biodistribution are needed. The unique Albufuse Flex technology solves this problem and will result in enhanced treatment efficacy, more favorable dosing regimes, and improved patient compliance."

"The successful development of the Albufuse Flex technology illustrates the importance of industry and academic collaboration in turning scientific excellence into products that address medical needs. Novozymes has been an outstanding partner throughout the development process, and the company truly understands the potential of our academic science," says Dr Jørund Sollid, Inven2 AS, the university technology transfer office.

Albufuse®Flex is a registered trademark of albumin fusion technology. For further information on Novozymes' new Albufuse Flex technology, please visit www.biopharma.novozymes.com.

Alliqua, Inc. Expands Patent Portfolio for Transdermal Drug Delivery Platform

Business Wire: May 4, 2011 – NEW YORK, NY – Alliqua, Inc. (OTCBB: ALQA) (FWB: HL1) ("Alliqua" or the "Company"), an advanced biomedical products company focused on the development and manufacturing of proprietary drug delivery and liver health technologies, today announced that it has filed a provisional patent application with the U.S. Patent and Trademark Office to enhance its transdermal delivery technology. The filing was based on positive test results with respect to specific chemical agents that improved the delivery of active ingredients when used in conjunction with the Company's hydrogel drug delivery platform. The patent application is directed to specific formulations that management believes will enhance the performance of its platform.

David Stefansky, Chairman of Alliqua, Inc., stated, "This patent filing is the second in a series of filings that we hope to continue as we develop additional improvements and processes. These filings are a meaningful step in building our intellectual property portfolio, strengthening our drug delivery platform position, and in increasing shareholder value."

Alliqua, Inc. Announces Preparation of IND for PHN Patch

Business Wire: May 3, 2011 – NEW YORK, NY – Alliqua, Inc. (OTCBB: ALQA) (FWB: HL1) ("Alliqua" or the "Company"), an advanced biomedical products company focused on the development and manufacturing of proprietary drug delivery and liver health technologies, announced today that it had commenced work on an investigational new drug application ("IND") for the Company's PHN patch project for submission to the FDA. The Company also announced that it had received encouraging results from a new *in vitro* test related to the Company's drug delivery platform.

Richard Rosenblum, President of Alliqua, commented, "We are extremely pleased with the continued progress of our transdermal delivery platform." David Stefansky, Chairman of Alliqua, further stated, "We are very excited about our products and their long-term potential. Our novel formulations, in conjunction with our delivery platform, create a unique opportunity to enter the estimated $1.4 billion PHN market." PHN (postherpetic neuralgia) is associated with shingles, which is a rising medical problem in the United States and around the world, as countries continue to struggle with increasingly elderly populations.

MicroDose Therapeutx Announces Achievement of Development Milestone

Business Wire: May 2, 2011 – MONMOUTH JUNCTION, NJ – MicroDose Therapeutx, Inc. (MicroDose) today announced that a development milestone in its collaboration with Novartis has been achieved, triggering a payment under the multi-product development and licensing agreement for the MicroDose proprietary dry powder inhaler (DPI). This milestone signals the successful incorporation of MicroDose's DPI technology into a Novartis platform pulmonary device.

As previously announced, under the terms of the agreement, Novartis is funding development and commercialization of products that employ MicroDose's DPI technology for the administration of Novartis' proprietary respiratory compounds. In addition to the upfront payment received, MicroDose is eligible for additional milestone payments and royalties on product sales.

"MicroDose is pleased to announce the achievement of this milestone," commented David Byron, Vice President of Research and Development, MicroDose. "The collaboration with Novartis has yielded a platform embodiment of MicroDose's DPI technology for Novartis to use in advancing development of a number of their proprietary respiratory pipeline products."

April 2011

Iroko Pharmaceuticals Acquires iCeutica to Bolster Capabilities in Novel Low-Dose NSAIDs

Business Wire: April 28, 2011 – PHILADELPHIA, PA – Iroko Pharmaceuticals, LLC today announces that it has acquired iCeutica, Inc. to further strengthen Iroko's position as the leading developer of novel, low-dose non-steroidal anti-inflammatory drugs (NSAIDs).

Through this acquisition, Iroko obtains iCeutica's patented SoluMatrix™ Platform, which reduces drug-particle size to enhance drug dissolution in the body. Under an earlier agreement with iCeutica, Iroko has already applied this nanotechnology platform to formulate three NSAIDs now progressing to Phase III clinical development. With the acquisition, Iroko also obtains another nanoformulated NSAID, meloxicam, and a muscle-relaxant used in pain relief, metaxalone, both of which are also advancing in clinical development.

"We are building an industry-leading pipeline to meet a clear public-health directive defined by the U.S. Food and Drug Administration," said John Vavricka, Iroko's President and Chief Executive Officer. "That directive is to deliver NSAIDs, one of the largest classes of pain-relieving medicines, at the lowest possible dose for the shortest possible duration."

"We are initiating several Phase III trials of nanoformulated products that have clear medical and commercial promise. They are designed to be administered at lower doses without compromising onset of action and effectiveness. In addition, we anticipate other benefits of the nanoformulation resulting from their fast dissolution."

Matthew Callahan, Executive Director and Chief Executive Officer at iCeutica, said, "Combining iCeutica and Iroko is a natural synergy and will bring significant resource to bear in progressing our portfolio and developing further applications of our platform."

Under the merger agreement, Iroko will pay an undisclosed amount to acquire 100% of iCeutica shares. Both companies are privately held. The current Iroko Board of Directors will serve as the Board for the combined companies, though Iroko and iCeutica will go forward as separate operating units. Iroko and iCeutica will maintain Philadelphia as their headquarters and iCeutica will continue its research operations in both Philadelphia and Perth, Australia.

Data on VIVITROL®, the New FDA-Approved Medication for Prevention of Relapse to Opioid Dependence, Published in The Lancet

Business Wire: April 27, 2011 – WALTHAM, MA – Alkermes, Inc. (NASDAQ: ALKS) today announced that results from the phase 3 clinical study of VIVITROL® (naltrexone for extended-release injectable suspension) in opioid dependence have been published by The Lancet. The six-month, phase 3 trial met its primary endpoint and showed significantly greater opioid-free weeks among patients treated with VIVITROL, compared to placebo. VIVITROL is the first and only non-addictive, non-narcotic, once-monthly medication approved by the U.S. Food and Drug Administration (FDA) for the prevention of relapse to opioid dependence, following opioid detoxification. VIVITROL should be used along with psychosocial support such as counseling. In contrast to conventional agonist therapies that maintain stimulation of opioid receptors, VIVITROL is an opioid-blocking antagonist that, when administered once per month, occupies the opioid receptor, thereby helping to prevent patients from relapsing to opioid dependence.

"There has been a dramatic increase in the prevalence of opioid dependence, which is a serious, life-threatening disease characterized by high rates of relapse, yet there are so few medications available to treat opioid dependence," stated Evgeny Krupitsky, M.D., Ph.D., Professor of Psychiatry, St. Petersburg State Pavlov Medical University and Head of the Department of Addictions at the Bekhterev Research Psychoneurological Institute. "The robust data from this phase 3 clinical trial showed that treatment with VIVITROL helped opioid-dependent patients remain drug-free with just one injection per month. VIVITROL is the only once-monthly medication that offers patients and physicians a non-narcotic treatment option to help fight this challenging disease."

The pivotal study also met all secondary endpoints, including opioid craving, self-reported opioid use, study retention rate, and

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incidence of physical opioid dependence. Patients in both the VIVITROL and placebo groups received counseling. "To date, there has been strong recognition from addiction experts and the treatment community that VIVITROL is an important new treatment option for opioid dependence, and the publication of the phase 3 data is an opportunity for us to more broadly share the comprehensive clinical results demonstrating VIVITROL's safety and efficacy with the addiction treatment community," said Richard Pops, Chief Executive Officer of Alkermes. "Alkermes is committed to advancing the field of addiction treatment through the development of new medications that help patients better manage their disease."

In the phase 3 study, patients treated once-monthly with VIVITROL demonstrated statistically significant higher rates of opioid-free urine tests during the evaluation phase, compared to patients treated with placebo, as measured by the cumulative distribution of opioid-free urine tests ($p<0.0002$). Data showed that the median patient taking VIVITROL had 90% opioid-free urine tests. A greater percentage of patients in the VIVITROL group remained in the study compared to the placebo group. Safety was assessed through monitoring of treatment-emergent adverse events, vital signs, biochemistry and hematology urine/blood tests including liver function tests, physical examination of injection sites, and baseline and endpoint electrocardiograms. VIVITROL was generally well tolerated in the study; two patients in each treatment arm discontinued due to adverse events. The most common clinical adverse events experienced by patients receiving VIVITROL during the study were hepatic enzyme elevations, nasopharyngitis, and insomnia.

NanoBio® Announces Development of Nasal Vaccine for the Prevention of Urinary Tract Infections in Collaboration with the University of Michigan

Business Wire: April 20, 2011 – ANN ARBOR, MI – NanoBio Corporation today announced a licensing agreement with the University of Michigan that provides NanoBio with rights to an antigen that has been shown to prevent urinary tract infections (UTIs) following intranasal vaccination.

Through the agreement, NanoBio gains access to an antigen that University of Michigan researchers have shown can prevent recurring UTIs by eliminating *E. coli* bacteria in the urinary tract. The associated study involved immunizing mice intranasally with the antigen coupled with an adjuvant that is not approved for human use. To continue progressing toward a resolution for the millions of women who suffer from painful and often recurrent UTIs, a safe and effective vaccine is necessary.

NanoBio plans to pair the UTI antigen with the company's nanoemulsion-based NanoStat® adjuvant technology as the intranasal delivery mechanism for the vaccine. Once it is proven that the nanoemulsion-based vaccine achieves similar success in mice, it is anticipated that a human clinical trial will follow. The NanoStat adjuvant technology has been proven safe and effective in a previous clinical study of NanoBio's intranasal influenza vaccine.

According to the National Institute of Diabetes and Digestive and Kidney Diseases, 53 percent of women suffer from UTIs annually and nearly 500,000 are hospitalized as a result. Approximately one in five women who experience a UTI will have recurrent UTIs. Generally, UTIs are treated with a course of antibiotics to clear the infection; however, a clinically proven therapy for preventing UTIs is not available today. UTIs led to more than $3.5B in evaluation- and treatment-related costs in 2000.

"*E. coli* causes nearly 90 percent of all UTIs. It is a common bacterium and is frequently treated with antibiotics, which has led to the emergence of drug resistant strains that are difficult to treat," said Harry Mobley, Ph.D., The Frederick G. Novy Collegiate Professor of Microbiology and Immunology, and Chair and Professor, Department of Microbiology and Immunology, University of Michigan. "We previously anticipated at least ten years of further development of the vaccine before reaching commercialization; however, partnering with NanoBio and using their NanoStat technology will significantly accelerate the development of this long-awaited vaccine."

"Several attempts at developing a UTI vaccine have been unsuccessful as antibodies from blood have limited access to mucosal surfaces such as the urinary tract where these infections occur," said Ali I. Fattom, Ph.D., Senior Vice President Vaccine Research and Development, NanoBio. "We are confident the combination of effective UTI antigens with NanoBio's NanoStat adjuvant platform technology will result in strong mucosal immunity that can prevent these infections. We have recently shown in our influenza vaccine clinical studies that the NanoStat adjuvant is safe and mucosal immunity is enhanced significantly. These findings will facilitate the development of a safe and effective vaccine against mucosa-associated infections in the urinary tract."

Actient Pharmaceuticals LLC Acquires U.S. Rights to STRIANT from Columbia Laboratories

Business Wire: April 20, 2010 – LIVINGSTON, NJ – Columbia Laboratories, Inc. (Nasdaq: CBRX) has entered into an asset purchase agreement with Actient Pharmaceuticals LLC ("Actient"), a privately-held specialty therapeutics company, for STRIANT® (testosterone buccal system) in the United States.

Under this agreement, Columbia has sold STRIANT to Actient for a combination of cash upfront and royalties on annual sales of STRIANT above a certain threshold. The Company also licensed to Actient certain intellectual property related to the underlying progressive hydration technology for use in the treatment of hypogonadism and other indications related to low testosterone levels in men.

The acquisition of STRIANT is consistent with Actient's strategic focus in urology, and enhances Actient's offering of pharmaceuticals, medical devices, and diagnostic solutions to the urology community.

Gilead and MicroDose Therapeutx Announce License and Collaboration Agreement to Develop MDT-637 for Treatment of Respiratory Syncytial Virus

Business Wire: April 20, 2011 – FOSTER CITY, CA & MONMOUTH JUNCTION, NJ – Gilead Sciences, Inc. (Nasdaq: GILD) and MicroDose Therapeutx, Inc. today announced that the companies have entered into an exclusive worldwide license and collaboration agreement for the development and commercialization of MDT-637, MicroDose's inhalable small molecule antiviral fusion inhibitor for the treatment of respiratory syncytial virus (RSV).

Under the terms of the agreement, Gilead will pay MicroDose an upfront payment and provide research funding to support MicroDose's continued development of MDT-637 through Phase IIa clinical trials. Gilead can assume full responsibility for clinical development following Phase IIa. MicroDose also could receive additional payments based upon the achievement of certain development, regulatory, and commercial milestones, as well as development fees and royalties on future potential net sales.

MDT-637 is a fusion inhibitor that has been shown to block RSV infection in preclinical testing. The product is formulated for pulmonary delivery via MicroDose's proprietary dry powder inhaler, which allows for rapid delivery to the site of infection (in the respiratory tract). MicroDose plans to file the Investigational New Drug (IND) reactivation with the U.S. Food and Drug Administration (FDA) and to initiate a Phase I study this year with MDT-637.

"This strategic collaboration is a significant milestone in MicroDose's vision to develop first-in-class therapies for major unmet medical needs," said Anand Gumaste, President and CEO of MicroDose. "Given Gilead's scientific and clinical expertise in virology, this partnership provides a strong validation of the potential for MDT-637 to become an important therapeutic advance for those affected by RSV infection."

"There is an urgent need to improve upon RSV treatment and care," said Norbert W. Bischofberger, Ph.D., Gilead's Executive Vice President, Research and Development and Chief Scientific Officer. "We believe this program aligns well with our expertise in both antiviral and respiratory drug development and we look forward to working with the MicroDose team to advance MDT-637 into clinical testing."

Precision NanoSystems and Alnylam Form New Delivery Collaboration

Business Wire: April 19, 2011 – VANCOUVER, BC & CAMBRIDGE, MA – Precision NanoSystems, Inc. and Alnylam Pharmaceuticals, Inc. (Nasdaq: ALNY), a leading RNAi therapeutics company, announced today that the two companies have formed an exclusive collaboration focused on the discovery and development of novel lipid nanoparticles, known as small lipid nanoparticles ("sLNPs"), using microfluidics technology. Based on their small particle size of approximately 20 nanometers, sLNPs have the potential for broadened biodistribution beyond liver delivery.

"We look forward to working with Precision NanoSystems to support research efforts around the discovery of novel sLNPs that we believe have the potential to significantly improve and broaden biodistribution," said Kenneth Koblan, Ph.D., Chief Scientific Officer at Alnylam. "sLNPs represent an exciting and innovative approach in Alnylam's advancement of proprietary LNPs for RNAi therapeutics."

"We are excited to have formed this exclusive collaboration with Alnylam focused on the discovery and development of novel sLNPs using microfluidics technology," said James Taylor, Ph.D., Chief Executive Officer of Precision NanoSystems. "Alnylam is leading the translation of RNAi technology into human therapeutics, and we look forward to working with them."

Vyteris Closes Merger with MediSync BioServices – Initiates Contract Research Organization Consolidation Strategy

Business Wire: April 18, 2011 – FAIR LAWN, NJ – Vyteris, Inc. (OTC/BB: VYTR) today announced that on April 6, 2011, the Company closed on its previously announced agreement to merge with MediSync BioServices, Inc., now a wholly owned subsidiary of Vyteris focused on the potential consolidation of high-value, niche contract research organizations (CRO), site management organizations (SMO) and related businesses within the $22 billion CRO industry.

Founded in 2006, MediSync intends to acquire and consolidate dermatological CROs and related businesses, including SMOs, which sub-contract clinical trial-related responsibilities from CROs and pharmaceutical/biotechnology companies.

"With MediSync we look to advance our strategy for consolidation, growth, and profitability in an established industry with exciting growth potential. MediSync's current and possible future operations intend to potentially serve a growing demand for outsourced clinical research and related services as drug and medical device developers may be attracted to the efficiency and flexibility offered by our CROs," said Haro Hartounian, Ph.D., Chief Executive Officer at Vyteris.

"MediSync provides us with a platform to broaden our corporate strategy, bringing both a revenue potential and execution expertise. The combined company represents a distinct opportunity in the life sciences industry that is guided by a team with a strong track record of value creation," he added.

MediSync's strategy is focused on bringing together established and profitable privately held CROs and related consulting firms to build a specialized cluster of businesses with complementary services that benefit from centralized administration, enhanced access to expansion capital, and cross-selling capabilities. MediSync is pursuing acquisition targets that it intends to advance to closing in 2011 and 2012.

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Neurotech's NT-501 Implant Demonstrates Statistically Significant Photoreceptor Preservation in Patients with Retinal Degenerative Disease

Business Wire: April 14, 2011 – LINCOLN, RI – Neurotech Pharmaceuticals, Inc., today announced that, as reported in Investigative Ophthalmology & Visual Science (April, 2011, Vol. 52), the Company's product candidate NT-501 demonstrated statistically significant cone photoreceptor preservation in patients with retinitis pigmentosa (RP)—a slowly developing condition that causes the progressive bilateral degeneration of photoreceptor cells in the retina, eventually resulting in blindness. NT-501 is an intraocular implant that consists of human cells genetically modified to secrete ciliary neurotrophic factor (CNTF)—a nerve growth factor capable of rescuing and protecting dying photoreceptors. The study utilized Adaptive Optics Scanning Laser Ophthalmoscopy (AOSLO), a breakthrough diagnostic technology, to image and measure the rate of the progressive degeneration of cone photoreceptors. AOSLO overcomes a major obstacle in the study of retinal degeneration—the non-invasive measurement of cone photoreceptor cells and their rate of degeneration in the eyes of living subjects.

In the prospective study, two patients with RP and one patient with Usher syndrome type 2, a rare genetic disorder characterized by vision loss due to RP and bilateral hearing loss, were evaluated by AOSLO at baseline and at 3, 6, 12, 18, and 24 months following implantation. Patients studied were selected from Neurotech's Phase 2 NT-501 study in patients with early-stage RP. For each patient, one eye received an NT-501 implant while the fellow eye received sham-treatment. AOSLO quantitatively assessed photoreceptor loss by measuring cone density and average cone spacing at several prospectively identified locations in the retina of each patient, aggregating repeated measures for all data points, and comparing results for the active- and sham-treated eyes. No increase in cone spacing or decrease in cone density was observed in any of the eyes treated with NT-501. An increase in cone spacing and a decrease in cone density are both indicative of photoreceptor loss. In addition, the results demonstrated a statistically significant preservation of cone photoreceptors in the eyes of all three subjects treated with the NT-501 implant versus sham-treated eyes. Cone spacing increased by 2.9% more per year in sham-treated eyes than in NT-501-treated eyes ($p<0.001$), and cone density decreased by 9.1% more per year in sham-treated eyes than in NT-501-treated eyes ($p=0.002$).

The study was led by Jacque Duncan, M.D., Professor of Clinical Ophthalmology, University of California, San Francisco, and Austin Roorda, Ph.D., Professor of Optometry and Vision Science, Chair and Head Graduate Advisor in the Vision Science Program, University of California, Berkeley. Dr. Duncan commented, "We are extremely encouraged by the photoreceptor preserving effect of NT-501 seen in this study as well as the usefulness of AOSLO as a diagnostic tool for retinitis pigmentosa progression. Larger studies using AOSLO are urgently needed to confirm the photoreceptor protective effect of NT-501 treatment in patients with retinal degeneration."

Paul Sieving, M.D., Ph.D., Director of the National Eye Institute and Principal Investigator of Neurotech's Phase 1 study of NT-501 in RP, commented, "These results suggest that AOSLO may play a meaningful role in the early assessment of photoreceptor loss due to retinitis pigmentosa well before serious functional loss is detected by standard measures of visual function, and that NT-501 may play an important neuroprotective role."

"These exciting results add to the growing body of evidence that NT-501 will benefit individuals who suffer from retinitis pigmentosa and other retinal degenerative diseases," stated Ted Danse, Chief Executive Officer of Neurotech. "Given the slow progression of these diseases, measuring improvements in visual function appears to require extremely lengthy trials. We believe tools such as AOSLO that measure photoceptor preservation can play an important role in defining meaningful and measurable near-term benefits of treatment of such slow-progressing, debilitating diseases," added Danse.

TARIS Closes $18.3 Million Series B Financing

Business Wire: April 13, 2011 – LEXINGTON, MA – TARIS Biomedical®, a specialty pharmaceutical company pioneering the development of innovative, targeted therapies using drug delivery to treat bladder diseases, announced today that it has raised $18.3 million of new capital in connection with its Series B equity financing. Third Rock Ventures, a new investor, led the round and all existing TARIS investors, Flagship Ventures, Flybridge Capital Partners, and Polaris Venture Partners, participated. The company's prior bridge financing was also converted into equity in connection with the round.

"This round of funding demonstrates the significant progress we have made, and validates our investors' belief in the potential of TARIS's proprietary platform to develop innovative therapeutics for genitourinary diseases," said Sarma Duddu, Ph.D., President and CEO, TARIS Biomedical®. "This investment will allow us to advance our lead product candidate, Lidocaine Releasing Intravesical System (LiRIS®), into later stage clinical development for the treatment of multiple bladder disorders, and to continue to build the rest of our pipeline of novel therapeutics, leveraging common, minimally invasive urological procedures." TARIS recently announced that it has initiated clinical testing in moderate to severe interstitial cystitis patients.

In connection with this financing transaction, Cary Pfeffer, M.D., of Third Rock Ventures will join the Board of Directors of TARIS Biomedical. He joins board members Dennis A. Ausiello, M.D., Massachusetts General Hospital; Kevin J. Bitterman, Ph.D., Polaris Venture Partners; Michael J. Cima, Ph.D., Massachusetts Institute of Technology; Sarma Duddu, Ph.D., TARIS Biomedical; Michael A. Greeley, Flybridge Capital Partners; Ed Kania, Flagship Ventures; Robert S. Langer, Sc.D., Massachusetts Institute of Technology; and Ernest Mario, Ph.D., PPD Inc.

"TARIS is building an industry-leading drug-device convergence platform in the emerging field of sustained therapeutic delivery to the bladder," said Cary Pfeffer, M.D., Partner at Third Rock Ventures. "We at Third Rock Ventures are enthusiastic about the potential of the TARIS core technology and I look forward to working with TARIS's leadership team as they advance programs with the potential for significant improvements over current treatment options."

Applied Research and Photonics, Inc. Receives 2011 CLEO/Laser Focus World Innovation Award

Business Wire: April 12, 2011 – WASHINGTON, DC – The CLEO: 2011 co-sponsors (APS, IEEE Photonics Society, OSA) and Laser Focus World today announced Applied Research and Photonics, Inc. as the winner of this year's CLEO/Laser Focus World Innovation Award. The award recognizes the company "for the development of a highly sensitive, low-power terahertz scanning reflectometer capable of directly measuring both the concentration gradient and kinetics of permeation of an ingredient across the thickness of a substrate in real time and in a non-invasive fashion." Applied Research and Photonics will accept the award at the CLEO Plenary Session on Monday, May 2 at 6 p.m. at the Baltimore Convention Center.

Currently, non-invasive measurement of the interior of various surfaces is a complex, multi-technique process. No direct method to obtain two critical factors—the concentration gradient of a permeating ingredient across the thickness of a substrate (e.g., skin) and the kinetics (i.e., rate) of such permeation—is thought to have previously existed.

The device will have applications in many areas of life sciences and physical sciences, including front-cell characterization of skin and other biological tissues, transdermal drug delivery, personal care products, and other substrate/active characterizations where the effect of an active ingredient on a substrate is important. In addition, the reflectometer will have uses in the optics and semiconductor industries, where interior substrate measurements are important.

"This invention, a terahertz scanning reflectometer, is capable of measuring both the concentration gradient and the kinetics of diffusion in real time," said Anis Rahman, CEO of Applied Research and Photonics, Inc. "We are excited about the impact this product will have in the industry and honored to be recognized by CLEO, Laser Focus World and the laser science community for this breakthrough in the world of lasers and optics."

"This year, we received a number of potential award-winning submissions presenting significant advances in the field of lasers and electro-optics," said Stephen Anderson, associate publisher and editor-in-chief, Laser Focus World. "Every year we continue to be amazed by the level of innovative technology advances being made by CLEO exhibitors. We are honored to recognize Applied Research and Photonics, Inc. and the two honorable mention companies for their significant impact on the optics industry." For more information on the CLEO/Laser Focus World Innovation Awards, visit the CLEO: 2011 website.

Yissum Presents Promising Pre-Clinical Results for Oral Delivery of the Anti-Cancer Drug Docetaxel Using a Novel Nanotechnology Approach

Business Wire: April 12, 2011 – JERUSALEM, ISRAEL – Yissum Research Development Company Ltd., the technology transfer company of the Hebrew University of Jerusalem, announced today successful pre-clinical data of oral delivery of Docetaxel, an anti-cancer drug, utilizing a novel nanotechnology platform. The technology, invented by Professor Simon Benita, Head of Institute for Drug Research, the School of Pharmacy, Faculty of Medicine at the Hebrew University, enables controlled drug release and increased bioavailability of orally administered lipophilic drugs. The findings were published by the prestigious Cancer Research journal.

Oral administration of lipophilic drugs is particularly challenging because they are both metabolized and actively expelled from the intestine. One of the main culprits is a protein pump called P-glycoprotein that transports the drugs back into the intestinal lumen after they have been absorbed into the body. One such lipophilic drug is Docetaxel, an anticancer drug widely prescribed for the treatment of various types of solid tumor cancer. Docetaxel is poorly soluble in water and vigorously pumped out of the intestine wall cells by P-glycoprotein. Therefore, this drug is delivered solely by intravenous infusion, after being solubilized by surfactants, which often increase adverse side effects. The innovative drug delivery technology involves the formation of drug nano-capsules that are then packed in microparticles in a manner that prevents metabolism and expulsion of the drug from the gut. The result is enhanced oral bioavailability along with prolonged release of the drug.

The data of the pre-clinical trials performed on rodents showed that the oral bioavailability of the drug embedded in the novel microparticles was 10 to 20 fold higher than other oral delivery methods, and the levels of the drug were high in the bloodstream. Despite the high blood levels achieved, the rats did not suffer from immediate side effects, indicating that the drug did not interact with the gut mucosal tissue. The anti-cancer activity of the novel formulation was demonstrated in cell cultures.

In June 2009, Yissum signed a collaborative agreement with Aurum Ventures MKI, the technology investment arm of Mr. Morris Kahn, for the further development of this oral drug delivery platform.

"Docetaxel is used for the treatment of a variety of cancers, and is currently administered as a high dose infusion every three weeks, resulting in side effects that could be quite severe," said Yaacov Michlin, CEO of Yissum. "Patients in need of this drug will thus greatly benefit from the ability to receive the drug in lower doses using an oral route. The recently published preclinical trials show that Prof. Benita's invention, currently

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being developed by Aurum Ventures MKI, has a real potential to offer cancer patients an oral delivery route for Docetaxel. The new delivery platform has been previously shown to be effective also for other drugs, and offers a revolutionary method to bypass specific potent barriers in the intestine and the liver, thereby greatly increasing bioavailability."

Prof. Benita added, "This unique system may allow changing the route of administration of highly lipophilic P-glycoprotein substrate drugs from injectable to oral with potentially high bioavailability and lower side effects without affecting the normal physiological activity of the metabolic filters."

Merck & Co., Inc., and Sun Pharma Establish Joint Venture to Develop and Commercialize Novel Formulations and Combinations of Medicines in Emerging Markets

Business Wire: April 11, 2011 – WHITEHOUSE STATION, NJ & MUMBAI, INDIA – Merck & Co., Inc. (NYSE:MRK), a global health care leader, known as MSD outside the United States and Canada, and Sun Pharmaceutical Industries Ltd. ("Sun Pharma"), a leading Indian multinational pharmaceutical company, today announced the creation of a joint venture to develop, manufacture, and commercialize new combinations and formulations of innovative, branded generics in the Emerging Markets.

"Merck's Emerging Markets strategy is driven by our overarching focus on applying innovation across our business from introducing novel compounds to broadening our focus on innovative branded generics," said Kevin Ali, president, Emerging Markets, Merck/MSD. "By combining forces with Sun Pharma, we are complementing our innovative product portfolio with a solid foundation for addressing the diverse needs of patients, physicians, and governments across the Emerging Markets."

The partnership combines Sun Pharma's proven track record of leadership and expertise in rapid, innovative product development using Sun Pharma Advanced Research Company Ltd's ("SPARC") proprietary platform technologies, and Sun Pharma's world-class manufacturing network with Merck's clinical development and registration expertise and a broad, geographic commercial footprint. The companies said that they will focus on "innovative branded generics" that bring together combinations of medicines using platform delivery technologies designed to enhance convenience for patients in Emerging Markets. The joint venture will be structured through Merck and Sun Pharma's respective subsidiaries. Financial details of the joint venture were not disclosed.

"This joint venture reinforces our strategy of partnering to launch products using our highly innovative delivery technologies around the world," said Dilip S. Shanghvi, chairman and managing director, Sun Pharmaceutical Industries Ltd. "Merck has an unrivalled reputation as a world leading, innovative, research-driven pharmaceutical company. We're proud to be associated with them and look forward to working together."

Experts estimate that during the coming decade, the Emerging Markets are expected to drive 90 percent of the world's pharmaceutical growth, with 75 percent of that growth coming from branded generics. In these markets, the growing burden of chronic disease, such as cardiovascular disease, diabetes, and hepatitis, along with an increasing population and economic prosperity, is leading to an increased demand for branded generics.

"Merck has a proud legacy of developing innovative medicines and vaccines with proven ability to impact global human health," said Ali. "We are making good progress executing on our Emerging Markets growth strategy by establishing novel partnerships and strategic alliances. This joint venture helps position us for leadership in the fastest growing geographies." The collaboration between MSD and Sun Pharma will be managed by a Joint Board and leadership team, consisting of members of senior management from both companies.

Diamyd Medical: Diamyd Results from Phase I Clinical Trial in Cancer Pain Published in Annals of Neurology

Business Wire: April 11, 2011 – STOCKHOLM, SWEDEN – Diamyd Medical's Phase I clinical trial results evaluating the safety and efficacy of the candidate drug NP2 Enkephalin to treat intractable cancer pain has been published in the medical journal Annals of Neurology.

The publication, entitled "Gene Therapy for Pain: Results of a Phase I Clinical Trial," details the results of Diamyd's Phase I dose-escalation clinical trial of NP2 Enkephalin through the four month evaluation period. The paper is accepted for publication in the medical journal Annals of Neurology and is available online as a pre-print. The study was designed to provide an assessment of the safety of three different doses of NP2 Enkephalin and also to investigate efficacy measurements of pain relief in subjects suffering from chronic pain due to malignancy. Substantial and sustained pain relief was noted in the middle and high dose cohorts in both pain measurement methods used in the study; the numeric rating scale (NRS), which is a scale of 0–10, and the Short Form McGill Pain Questionnaire (SF-MPQ), which is a quantitative compilation of 15 descriptive pain measures. In the highest dose cohort, an ~80% decrease in the combined average weekly NRS scores was observed over the first four weeks.

"A publication of the results from our first clinical trial with NP2 Enkephalin in Annals of Neurology underscores the interest from the medical community for our pioneering approach to treat pain," states co-author Darren Wolfe, President of Diamyd Inc., the U.S. subsidiary of Diamyd Medical, responsible for the development of the proprietary Nerve Targeting Drug Delivery System.

Ten subjects with moderate to severe cancer pain, despite treatment with the maximum tolerated dosages of standard opioid medications, were enrolled into the study. Safety evaluation of patients through four months indicates that delivery into the skin of NP2 Enkephalin is well tolerated with no observed treatment related serious adverse events.

Results are to be confirmed in an ongoing Phase II, randomized, double blind, placebo controlled clinical trial of NP2 Enkephalin in 32 patients with severe intractable cancer pain at approximately 10 clinical sites in the US. This study is currently enrolling participants.

The Nerve Targeting Drug Delivery System (NTDDS) represents a new class of pharmaceutical products that delivers gene-based drugs directly to nerve cells, providing a direct effect in the cells targeted by the treatment. The NTDDS based candidate drug NP2 Enkephalin has been engineered to deliver the human Enkephalin gene, which naturally produces opioid peptides involved in pain control. Further information is available on the company's website: www.diamyd.com.

CEA-Leti and 7 Partners to Study Ways to Improve Treatment of Inflammatory Bowel Disease

Business Wire: April 11, 2011 – GRENOBLE, FRANCE – CEA-Leti today announced a new project designed to develop a novel nanocarrier-based approach to improve the treatment of inflammatory bowel disease, an increasingly common condition in Europe.

The Delivering Nano-pharmaceuticals through Biological Barriers project, known as BIBA, involves eight partners in France, Germany, Spain, and Switzerland. BIBA is coordinated by CEA-Leti as part of its research program on organic nanocarriers and delivery systems for clinical applications like molecular imaging and drug delivery.

The three-year study is designed to develop an anti-inflammatory corticoid and/or an immunosuppressant encapsulated within a biodegradable nanocarrier for improved treatment of IBD and reduced side effects. Industry supervision of the preclinical proof of concept will enhance quality control to guaranty a faster regulatory application after the project.

Inflammatory bowel disease (IBD) includes Crohn's disease (CD) and ulcerative colitis (UC). Medical treatment of IBD is mostly based on the use of corticosteroid to induce remission and of an immunosuppressant to prevent relapses. But these approaches are inefficient in more than 70 percent of patients with CD, and 20 percent of the patients with UC who ultimately require surgery for control of the disease. Corticosteroids like prednisolone can induce remission in a high proportion (60–80 percent) of patients.

However, the required doses of steroids cannot be administered long-term due to adverse events. BIBA will investigate local delivery of encapsulated corticosteroids and immunosuppressants using two types of organic biodegradable nanocarriers to prevent side effects. Passive targeting of nano-delivery systems in inflamed tissues exploiting the so-called enhanced permeability and retention (EPR) effect is expected to increase the local concentration of corticoids in inflamed areas.

One model of corticoid, budesonide, and one model of immunosuppressant, cyclosporine, will be separately encapsulated in three dosage forms – oral, colonic, and intravenous – to maximize the delivery of anti-inflammatory drugs through the gastrointestinal tract, with two nanocarriers: lipid "baby bubbles" (Lipidots®) and poly(lactic-co-glycolic acid) (PLGA) particles. *In vitro* experiments will be performed on a lab model of healthy and pathological epithelium to screen the most relevant nano-pharmaceuticals.

Formulations will then be evaluated *in vivo* in appropriate rodent colitis models. Animal models allow both the examination of inflammatory processes (both early and late events) as well as the evaluation of new therapeutic modalities. Non-invasive magnetic resonance imaging (MRI) and optical fluorescence in combination with histological analysis will be used to monitor the effect of the therapy on the inflamed mucosa. For more information, visit www.leti.fr.

ICL Acquires Fuentes, Spain's Leading Specialty Fertilizers Company

PRNewswire: April 11, 2011 – TEL AVIV, ISRAEL – ICL (TASE: ICL), a multinational fertilizer and specialty chemicals company, today announced that it acquired Grupo Empresarial Agromediterraneo, S.L., the holding company of Antonio Fuentes Mendez S.A., ("Fuentes"), Spain's largest producer of specialty fertilizers, for an undisclosed sum. The purchase includes Fuentes' line of proprietary liquid and soluble fertilizers and bulk blends, its production facilities located in Totana and Cartagena, Spain, as well as warehouses, port facilities, and logistics centers located throughout southern and eastern Spain. Fuentes' 2010 revenues were approximately €113 million. Following the acquisition, Fuentes and its wholly-owned operating subsidiaries become a part of ICL Specialty Fertilizers, a business unit of ICL Fertilizers. ICL financed the acquisition from its own resources.

The acquisition of Fuentes establishes ICL as the leading supplier of specialty fertilizers in the rapidly-growing Spanish market. Fuentes markets a broad line of branded high-quality liquid and water soluble fertilizers (WSF) and bulk blends. It sells its products primarily in southern and eastern Spain, which accounts for 75% of the Spanish market for specialty fertilizers. In these regions, sales of WSF fertilizers are growing by 8% to 12% per annum, compared to relatively flat growth for traditional fertilizers. Fuentes also possesses strong R&D capabilities in the liquid and soluble fertilizers areas.

ICL's acquisition of Fuentes represents a further step by ICL in its strategy to broaden its activities in the specialty fertilizers

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sector, a market which it has identified as possessing the potential for strong growth. It follows ICL's recent $270 million purchase of the Global Professional business of The Scotts Miracle-Gro Company ("Global Pro"). These acquisitions establish ICL Specialty Fertilizers as a global $650 million specialty fertilizers company with a broad, recognized product portfolio of soluble, liquid, slow-release, and control release fertilizers, strong global sales and marketing capabilities, production facilities in the U.S., E.U., and Israel, and a particularly strong presence in Spain, the E.U.'s largest consumer of specialty fertilizers.

Mr. Yossi Zidon, Senior VP, ICL Specialty Fertilizers, added, "We are very excited to move forward so rapidly with our plan to build ICL into a major Special Fertilizers player. The acquisition of Fuentes builds our presence in Spain – an important end-market as well as a strategic gateway to Northern Africa and the E.U. – while building out our brands, sales, logistics and manufacturing capabilities. We welcome the entire Fuentes team into the ICL family and look forward to working together to accelerate the growth and profitability of ICL Specialty Fertilizers."

Antares Pharma Announces FDA Acceptance of Anturol® NDA for Filing

Business Wire: April 8, 2011 – EWING, NJ – Antares Pharma, Inc. (NYSE Amex: AIS) today announced the New Drug Application (NDA) for Anturol® Gel in patients with overactive bladder (OAB) was accepted for filing for review by the U.S. Food and Drug Administration (FDA). Anturol is an oxybutynin gel incorporating Antares' ATD Gel technology.

The FDA has assigned a Prescription Drug User Fee Act (PDUFA) date of December 8, 2011, ten months from the official NDA filing. The PDUFA date is the target date for the FDA to complete its review of the NDA.

"The FDA's acceptance of the NDA filing is an important milestone in the review process to secure approval from the FDA for commercial distribution of Anturol. We look forward to working with the FDA in their ongoing review of Anturol," said Kaushik J. Dave, R.Ph., Ph. D., MBA, Senior VP Product Development of Antares Pharma.

The Anturol NDA submission is supported by data from a Phase 3 randomized, double-blind, placebo-controlled clinical trial involving 600 patients with OAB. In the 12-week study, patients treated with Anturol 56 mg daily or 84 mg daily experienced a significant decrease in OAB symptoms versus placebo, including the number of urinary incontinence episodes per day. Anturol was well tolerated in the study with no reported serious treatment-related adverse events. Anticholinergic side effects such as dry mouth and constipation were low and no increase in CNS side effects was seen compared to placebo. The study was conducted under a Special Protocol Assessment (SPA) by the FDA.

"The FDA's acceptance for filing of the NDA for Anturol, Antares Pharma's first NDA, is another notable achievement for the Company resulting from the dedicated efforts of the entire Antares team. This is an important accomplishment in the continued execution of our product focused strategy," said Paul K. Wotton, Ph.D., President and Chief Executive Officer.

Impax Laboratories Enters into Commercialization Agreement with Banner Pharmacaps

Business Wire: April 8, 2011 – HAYWARD, CA & HIGH POINT, NC – Impax Laboratories, Inc. (NASDAQ: IPXL) today announced that it will collaborate with Banner Pharmacaps Inc. with respect to the supply and commercialization of two softgel capsule products. The products and terms of the agreement were not disclosed.

Larry Hsu, Ph.D., president and CEO of Impax Laboratories, said: "We are excited to collaborate with Banner, a global leader in developing and manufacturing softgel products. In less than a year, we have entered into four distinct partnerships for alternate dosage form products as we continue to execute our strategy of diversifying our product base. Our business development activities will continue to focus on delivering growth from high-value products, technologies, and businesses in complementary dosage forms."

Roger E. Gordon, Ph.D., president and CEO of Banner Pharmacaps Inc., added: "We are delighted to be joining forces with Impax, a specialty pharmaceutical company whose vision and goals so closely mirror those of Banner. They join our expanding list of partners who look to Banner to provide expertise in the development of gelatin-based drug delivery systems and unique technology platforms."

AlCana Technologies, The University of British Columbia, and Alnylam Extend Delivery Research Collaboration

Business Wire: April 7, 2011 – VANCOUVER, BC & CAMBRIDGE, MA – AlCana Technologies, Inc., The University of British Columbia, and Alnylam Pharmaceuticals, Inc. (Nasdaq: ALNY), a leading RNAi therapeutics company, announced today that Alnylam has elected to extend the companies' RNAi therapeutics research collaboration for a third year. The research collaboration was initiated in August 2009 and focused on the discovery of novel cationic lipids employed in lipid nanoparticles ("LNPs") for the systemic delivery of RNAi therapeutics.

"We are excited to continue our relationship with AlCana and UBC in this research collaboration, as they remain at the forefront of cationic lipid and LNP discovery with a world-class team of chemists focused on the delivery of RNAi therapeutics," said Kenneth Koblan, Ph.D., Chief Scientific Officer at Alnylam. "In fact, the research conducted by AlCana and UBC has led to the discovery of our second generation LNPs that demonstrate remarkable improvements in potency, a wider therapeutic index, and potential for delivery beyond the liver."

"We are pleased that Alnylam has elected to extend our research collaboration for another year and we look forward to continuing our work with them in these efforts," said Thomas Madden, Ph.D., President and Chief Executive Officer of AlCana Technologies. "Over the past two years, we have made significant advancements in the systemic delivery of RNAi therapeutics and the progress in our relationship is exemplified by the large number of papers and presentations by our scientific teams."

The research collaboration is funded by Alnylam and the work will be conducted by scientists at UBC and AlCana. Under the terms of the research agreement, Alnylam retains exclusive rights to all new inventions in the RNAi field as well as rights to sublicense any resulting intellectual property to Alnylam's current and future partners. As part of the original 2009 agreement, Tekmira Pharmaceuticals Corporation (Nasdaq: TKMR, TSX: TKM) receives rights to use any new AlCana/UBC inventions for their own RNAi therapeutic programs licensed under Alnylam intellectual property through its InterfeRx™ program.

Pfizer to Sell Capsugel to KKR

Business Wire: April 4, 2011 – PEAPACK, NJ – Pfizer and Kohlberg Kravis Roberts & Co L.P. (together with its affiliates, "KKR") today announced they have entered into an agreement whereby an affiliate of KKR will acquire Pfizer's Capsugel business for $2.375 billion in cash. Capsugel, the world leader in hard capsules and an innovator in drug-delivery systems, generated approximately $750 million in revenue and manufactured more than 180 billion hard capsules in 2010.

"The transaction is an endorsement of Capsugel's consistent success to date and its potential for future growth with KKR, a firm with deep industry expertise and a long history of partnering with market-leading businesses to take them to the next level," said Guido Driesen, President and General Manager of Capsugel. "Capsugel's employees and I are excited to work with KKR and eager to enhance the value of our business in partnership with our customers."

Henry R. Kravis and George R. Roberts, Co-Founders, Co-Chairmen, and Co-CEOs of KKR, stated, "Capsugel has an excellent portfolio and outstanding reputation for providing high-quality, innovative drug-delivery solutions. We look forward to working with Capsugel's talented employees and investing in this business. We share Capsugel's enthusiasm for its future potential to grow, develop, and continue to deliver an unmatched quality of products."

Capsugel will maintain a corporate presence in the United States, with its global headquarters located in New Jersey. All Pfizer colleagues currently dedicated to this business will be transferred to Capsugel, which will be under the leadership of Guido Driesen upon the completion of the transaction.

"Good Cholesterol" Nanoparticles Seek and Destroy Cancer Cells

PRNewswire: April 1, 2011 – FORT WORTH, TX & HOUSTON, TX – High-density lipoproteins haul excess cholesterol to the liver for disposal, but new research suggests "good cholesterol" can also act as a special delivery vehicle of destruction for cancer.

Synthetic HDL nanoparticles loaded with small interfering RNA to silence cancer-promoting genes selectively shrunk or destroyed ovarian cancer tumors in mice, a research team led by scientists from The University of Texas M. D. Anderson Cancer Center and the University of North Texas Health Science Center reports in the April edition of Neoplasia.

"RNA interference has great therapeutic potential but delivering it to cancer cells has been problematic," said Anil Sood, M.D., the study's senior author and M. D. Anderson's director of Ovarian Cancer Research and co-director of the Center for RNA Interference and Non-Coding RNA at M. D. Anderson. "Combining siRNA with HDL provides an efficient way to get these molecules to their targets. This study has several important implications in the ability to fight certain cancers."

Sood and Andras Lacko, Ph.D., professor of Molecular Biology and Immunology at UNT Health Science Center, jointly developed the nanoparticles, which build on Lacko's original insight about HDL's potential for cancer drug delivery. The next step is to prepare for human clinical trials, the two scientists said. "If we can knock out 70, 80, or 90 percent of tumors without drug accumulation in normal tissues in mice, it is likely that many cancer patients could benefit from this new type of treatment in the long run," Lacko said.

Previous studies have shown that cancer cells attract and scavenge HDL by producing high levels of its receptor, SR-B1. As cancer cells take in HDL, they grow and proliferate. The only other site in the body that makes SR-B1 receptor is the liver. This selectivity for cancer cells protects normal, healthy cells from side effects.

Previous attempts to deliver siRNA by lipsomes and other nanoparticles have been hampered by toxicity and other concerns. The tiny bits of RNA, which regulate genes in a highly targeted fashion, can't simply be injected, for example. "If siRNA is not in a nanoparticle, it gets broken down and excreted before it can be effective," Sood said. "HDL is completely biocompatible and is a safety improvement over other types of nanoparticles." The team developed a synthetic version of HDL, called rHDL, because it's more stable than the natural version.

Using rHDL as a delivery method has other advantages as well. rHDL has not shown to cause immunologic responses, helping to minimize potential side effects, Lacko said, and it exhibits longer time in circulation than other drug formulations or lipoproteins. Also, because SR-B1 is found only in the liver, an

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rHDL vehicle will help block and treat metastasis to that organ. Researchers first confirmed the distribution of SR-B1 and the uptake of rHDL nanoparticles in mice injected with cancer cells. They found that siRNA was distributed evenly in about 80 percent of a treated tumor. As expected, the nanoparticles accumulated in the liver with minimal or no delivery to the brain, heart, lung, kidney, or spleen. Safety studies showed uptake in the liver did not cause adverse effects.

Using siRNA tailored to the individual gene, the researchers separately shut down the genes STAT3 and FAK in various types of treatment-resistant ovarian cancer tumors. STAT3 and FAK are important to cancer growth, progression, and metastasis; however, they also play important roles in normal tissue, so targeting precision is vital.

The siRNA/rHDL formulation alone reduced the size and number of tumors by 60 to 80 percent. Combinations with chemotherapy caused reductions above 90 percent.

Conventional approaches to target STAT3 have met limited success, Sood said. FAK, which is over expressed in colorectal, breast, ovarian, thyroid, and prostate cancers, is particularly aggressive in ovarian cancer and one reason for its poor survival rate. While previous attempts have targeted FAK with liposomal nanoparticles or small molecule inhibitors, these methods are not tumor-specific and are more likely to harm normal cells, the scientists noted.

"In order to help expedite the study's progress to a clinical setting, we have identified 12 genes as biomarkers for response to STAT3-targeted therapy," Sood said. "Next, we'll work with the National Cancer Institute Nanoparticle Characterization Lab to develop a formulation of the HDL/siRNA nanoparticle for human use."

M. D. Anderson and UNT have applied for a patent for the nanoparticle delivery method. These arrangements are managed by M. D. Anderson (and UNT) in accordance with institutional conflict of interest policies.

March 2011

AlphaRx Receives Notice of Allowance for U.S. Patent on its Lead Pain Product Candidate

PRNewswire: March 24, 2011 – HONG KONG – AlphaRx Inc. (OTC BB:ALRX.OB) has received a Notice of Allowance from the United States Patent and Trademark Office for its lead pain product candidate code named ARX8203, a potentially safer drug intended for pain treatment. AlphaRx has developed three formulations using ARX8203, an injectable formulation for post-surgical pain, an oral capsule for chronic pain, and an ophthalmic formulation for ocular inflammation.

AlphaRx has eight further U.S. patent applications pending in different stages of examination and is confident that this is the first of many patents yet to receive allowance.

ULURU Inc. Announces the Granting of Altrazeal® Patent

PRNewswire: March 23, 2011 – ADDISON, TX – ULURU Inc. (NYSE AMEX: ULU) announced today that it has been issued U.S. Patent 7,910,135 – Hydrogel Wound Dressing and Biomaterials Formed *In Situ* and Their Uses. This patent provides additional coverage for Altrazeal® and, including The Patent Term Adjustment granted by the U.S. Patent and Trademark Office, extends patent coverage on Altrazeal® until January 2029.

The initial patent granted in 2007 that covers the NanoFlex® technology utilized in the manufacture of Altrazeal® was due to expire in November 2022. The granting of this patent is important in that it not only extends patent protection by over 6 years but it specifically covers our marketed product Altrazeal®. Additionally, this patent covers the controlled release of drugs and other active compounds, including growth factors that can be incorporated in the wound dressing.

Commenting on the patent grant, Kerry P. Gray, President and CEO of ULURU Inc., stated, "This patent is the cornerstone of our wound care franchise, for both our current product portfolio and our extensive pipeline of development candidates. This intellectual property adds significant value to the Altrazeal® asset due to the extension of patent coverage to 2029 and the subject matter covered. Achieving this patent in an environment where it is becoming increasingly difficult to have biomedical patents granted confirms the innovative and novel properties of Altrazeal® and the NanoFlex® Technology."

BioDelivery Sciences Announces Issuance of Patent in Canada Extending Exclusivity for the BEMA Technology to 2027 Covering ONSOLIS and BEMA Buprenorphine

PRNewswire: March 21, 2011 – RALEIGH, NC – BioDelivery Sciences International, Inc. (Nasdaq: BDSI) announced the issuance of a patent extending the exclusivity of the BioErodible MucoAdhesive (BEMA) drug delivery technology in Canada from 2017 to 2027. The patent was been reviewed by the Office of Patented Medicines for listing in the Canadian Patent Register and was found eligible for listing.

BEMA is BDSI's core drug delivery technology and the basis for its first commercialized product, ONSOLIS, as well as for BEMA Buprenorphine, which is currently in Phase 3 clinical development in the U.S. for the treatment of moderate to severe chronic pain. Canadian Patent No. 2,658,585 provides additional exclusivity relating to formulation characteristics for enhanced drug absorption from the BEMA drug delivery technology. This patent provides additional patent protection for ONSOLIS, BEMA Buprenorphine, and BEMA Buprenorphine/Naloxone, a potential treatment for opioid dependence.

ONSOLIS has been approved by regulatory authorities in Canada and will be marketed by Meda Valeant Pharma Canada Inc., a joint venture between BDSI's commercial partner Meda, and Valeant Canada Limited. ■

Controlled Release Society
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Calendar of Events

2011

38th Annual Meeting & Exposition of the Controlled Release Society

July 30–August 3
Gaylord National Hotel and Convention Center
National Harbor, MD, U.S.A.
www.controlledreleasesociety.org/main/meetings

71st FIP World Congress of Pharmacy and Pharmaceutical Sciences

September 2–8
Hyderabad, India
www.fip.org/congresses

Developing Pharmaceutical Products for Controlled Pulmonary Delivery

Sponsored by AAPS and CRS
October 23
Washington, DC, U.S.A.
www.controlledreleasesociety.org

2011 AAPS Annual Meeting and Exposition

October 23–27
Washington, DC, U.S.A.
www.aapspharmaceutica.com/meetings/annualmeet/AM11

2012

9th World Biomaterials Congress

June 1–5
New International Exhibition & Convention Center
Chengdu, China
www.wbc2012.com

39th Annual Meeting & Exposition of the Controlled Release Society

July 14–18
Centre des Congrès de Québec
Québec City, Canada
www.controlledreleasesociety.org/main/meetings