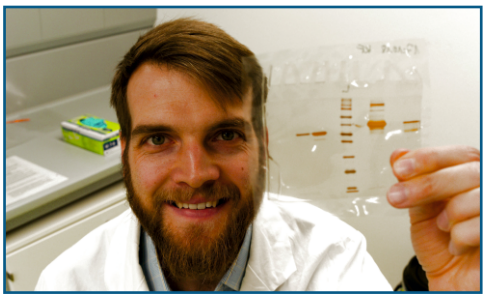
CRS FOCUS GROUP IN
NANOMEDICINE AND NANOSCALE DELIVERY

# MEMBER FEATURE ARTICLES


Focus Group
NANOMEDICINE AND NANOSCALE DELIVERY
CRS Controlled Release Society

Focus Group NANOMEDICINE AND NANOSCALE DELIVERY CRS Controlled Release Society

# GREGOR FUHRMANN



Head of Junior Research group Biogenic Nanotherapeutics (BION)

Helmholtz Institute for Pharmaceutical Research Saarland (HIPS),
Helmholtz Centre for Infection Research, Campus E8.1, 66123 Saarbrücken, Germany

@FuhrmannGregor

www.fuhrmann-lab.de

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

My aim is to engineer smart biogenic drug carriers utilising principles established in nature. BION is dedicated to using cutting-edge methodologies in nanoparticle formulation and imaging combined with tangible pharmaceutical expertise in the field of targeted drug delivery for treating infections and inflammatory dispositions.

## INTRODUCE YOURSELF

I studied pharmacy in Berlin and obtained my doctoral degree in 2012 from ETH Zurich at the Drug Formulation and Delivery department (Jean-Christophe Leroux). I received both a Marie Curie Intra European Fellowship and a German Academic Exchange Service (DAAD) scholarship to become postdoc at Imperial College London, Department of Bioengineering (Molly Stevens). Since 2016, I head of the Biogenic Nanotherapeutics (BION) group at HIPS, Germany, supported by the NanoMatFutur programme from the Federal Ministry for Research and Education. I received the technology prize of the Galenus Foundation in 2017 and the 2019 Young Investigator Award from the German Pharmaceutical Society (DPhG).

## RESEARCH BACKGROUND

Targeted drug delivery and protein functionalisation to treat bacterial infections and autoimmune-based dispositions.

## CURRENT RESEARCH INTERESTS

We are currently developing cell-derived extracellular vesicles (EVs) and bacterial vesicles from non-pathogenic bacteria as novel drug carriers for antibiotics. We recently discovered a new class of bacterial vesicles that are low in cytotoxicity but show inherent antibiotic activity against gram-negative model pathogens. We are also interested in protein formulation using liposomes and in the development of stimuli-responsive biomaterials to enhance the selectivity of antimicrobial therapy.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

Nanomedicine allows a tangible avenue to approach some of the most important therapeutic questions in pharmacy, such as resistant bacterial infections.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Eilien Schulz, Adriely Goes, Ronald Garcia, Fabian Panter, Marcus Koch, Rolf Müller, Kathrin Fuhrmann, Gregor Fuhrmann, Biocompatible bacteria-derived vesicles show inherent antimicrobial activity, *Journal of Controlled Release* (2018) 290:46.

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

I believe we need to work on personalising nanomedicine, both for carrier types and by using individualised drugs. Nanomedicine offers us a great variety of optimisation and engineering opportunities that we should take advantage of to achieve this aim.

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# GABRIELA ROMERO URIBE

Assistant Professor
Department of Biomedical Engineering and Chemical Engineering
BME Joint Graduate Program UTSA & UTHSA
Brain Health Consortium
The University of Texas at San Antonio

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

Dr. Gabriela Romero's research focus is in the development of hybrid and stimuli-responsive nanomaterial's platforms for the treatment of brain diseases.

## INTRODUCE YOURSELF

Since fall of 2017, Dr. Romero is an Assistant Professor in the Department of Biomedical Engineering and Chemical Engineering at the University of Texas at San Antonio (UTSA). Additionally, she is a member of the Brain Health Consortium at UTSA, and a joint faculty in the University of Texas Health San Antonio (UTHSA).

## RESEARCH BACKGROUND

Dr. Romero has twelve years research experience in nanomaterials for biomedical applications. She completed her PhD studies in Applied Chemistry and Polymeric Materials at the CIC biomaGUNE Institute in Spain. Her PhD work encompassed the design, fabrication and surface engineering of polymeric nanomaterials as carriers for drug delivery. Upon completing her PhD, she joined Dr. Berron's group as a postdoctoral research associate at the University of Kentucky. There, she worked on developing polymer coatings that enable the isolation of progenitor cells for the treatment of different diseases such as myocardial infarctions. Following, she joined Dr. Anikeeva's group at Massachusetts Institute of Technology for a second postdoctoral appointment. There, her research focused on designing and engineering magnetic nanoparticles systems for deep brain stimulation. Prior to join UTSA, Dr. Romero held a Senior Scientist position at Poseida Therapeutics, Inc. There, she designed and synthesized polymeric systems for the encapsulation and delivery of therapeutic proteins and plasmids.

## CURRENT RESEARCH INTERESTS

Dr. Romero's research interest lie within the field of Nanomedicine, and specifically the development of hybrid nanomaterials platforms that enable manipulation of signaling processes within the nervous system. Some of the brain health problems in which her research team is interested in include the fabrication of non-viral carriers to deliver gene-editing tools into the brain, the development of wireless platforms to modulate neural signals, the fabrication of biomimetic strategies that support nerve growth and the investigation of non-invasive pathways across the blood-brain-barrier.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

Dr. Romero has been able to pursue her passion for research through the design and development of nanomaterial's platforms focused on solving challenging biomedical problems. Dr. Romero believes that the careful design of materials for biomedical applications relies on the combined exploration and exploitation of biophysical and biochemical processes at the core of single molecule interactions. Her research aims to contribute in the advancement of technologies that interact with neural signals and brain tissues.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Gabriela Romero, Michael G. Christiansen, Ligia S. Barbosa, Francisco J. Garcia, Polina Anikeeva. Localized Excitation of Neural Activity via Rapid Magnetothermal Drug Release. *Advanced Functional Materials*, 2016, 6471-6478.

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# NURIA LAFUENTE GÓMEZ

PhD student
Institute of Advanced Studies in Nanoscience (IMDEA Nanociencia)

@Nuria_LG

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

I am a pharmacist working on the design and development of new tools based on magnetic nanoparticles for the treatment and diagnosis of cancer.

## INTRODUCE YOURSELF

Currently, I am a PhD student of the Nanobiotecnhology group under the supervision of Prof. Álvaro Somoza at Institute of Advanced Studies in Nanoscience (IMDEA Nanociencia) in Madrid. We are a multidisciplinary group working in the nanomedicine field to develop new agents for the diagnostic and treatment of different diseases such as pancreatic and breast cancer, uveal melanoma and Duchenne muscular dystrophy. In this scenario, my PhD project is focused on the functionalization of magnetic nanoparticles with molecules of interest (drugs, oligonucleotides, fluorophores, antibodies) for their potential use as diagnostic and therapeutic tools, mainly for pancreatic cancer. Moreover, the Nanobiotecnhology group is committed to the dissemination of science to society. For this reason, in October 2018, we launched the Youtube channel Nanobiotube. Besides, I am personally very interested in communicating science among children and young people. For this reason, I am a volunteer of non-governmental organizations, such as Cienciaterapia and Asociación Española contra el Cáncer. My main activities in these organizations are focused on the performance of experiments for kids at hospitals and schools, which I use to explain the importance of science in the society and the daily life of researchers.

## RESEARCH BACKGROUND

In terms of research, previously to my PhD project, I was working with a collaboration scholarship in the Chemistry and Pharmaceutical Sciences Department at the Faculty of Pharmacy of Universidad Complutense de Madrid. Under the guidance of Dr. Victoria Cabañas and Dr. Juan Luis Paris, I worked in the development of ceramic-hydrogel scaffolds with mesoporous silica nanoparticles loaded with antibiotics and angiogenic proteins to treat infections in bone prosthetics.

## CURRENT RESEARCH INTERESTS

My current research interests are the design of smart nanoparticles, the scalability of their production, and their potential as immunological tools for cancer treatment. I am convinced that immunotherapy will play a key role in the treatment of cancer, and in this context, nanomedicine can provide innovative tools to help in its development.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

Nanomedicine is a field of research that is having a huge impact in Health Sciences. The promising results that are being obtained are the main reason why I am devoted to it. In my opinion, many nanotherapeutics are going to go from the bench to the bedside in a short time and that is why working on nanomedicine for me is rewarding.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Paris J.L, Lafuente-Gómez N, Cabañas M.V, Román J, Peña J and Vallet-Regí M. Fabrication of a nanoparticle-containing 3D porous bone scaffold with proangiogenic and antibacterial properties, *Acta Biomaterialia*, 86: 441–449, 2019.

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

From my point of view, scalability in the production of large quantities of nanoparticles is the main challenge in nanomedicine nowadays. The difficult task now is to develop not exclusively efficient nanotools, but do it in a way that increases the chances to reach the clinic.

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# JOAN ONYEBUCHI EREBOR

BPharm, MPhil, CAPM, Ph.D.
Visiting Assistant Professor
Pharmaceutics Division
Department of Pharmacy Practice
College of Pharmacy & Pharmaceutical Sciences
The University of Toledo

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

I am a target driven, result oriented and committed pharmacist with experience in academia, the pharmaceutical industry, hospital pharmacy, retail pharmacy, cancer therapy and gene delivery research, alongside project management. Targeted nanomedicine formulation synthesis and evaluation are my most recent area of research.

## INTRODUCE YOURSELF

I am currently a Visiting Assistant Professor Pharmaceutics lecturing, instructing in the laboratory and mentoring graduate students and undergraduate students at the College of Pharmacy and Pharmaceutical Sciences, University of Toledo in Ohio.

## RESEARCH BACKGROUND

My research so far has covered formulating conventional tablets to advanced drug delivery systems that comprise of targeted hybrid nanocarriers for cancer therapy utilizing gene delivery and anticancer drugs. I previously lectured in the classroom and demonstrated in the laboratory to pharmacy undergraduate students in the Department of Pharmaceutics and Pharmaceutical Technology, University of Benin. I also successfully supervised undergraduate final year projects at the University of Benin. I was a Laboratory Demonstrator for Pharmacy Undergraduate Students, Strathclyde Institute of Pharmaceutical and Biomedical Sciences University of Strathclyde, Glasgow, United Kingdom.

## CURRENT RESEARCH INTERESTS

Current research interests involve formulation of targeted nanomedicines for chronic kidney disease (CKD).

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

Nanomedicine has impacted my career by giving me the opportunity to get a Faculty position in an area of the Pharmaceutical Sciences that I enjoy the most: Pharmaceutics. It has also given me the opportunity to network with talented individuals in the nanomedicine space that I would otherwise not be able to reach.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Joan Onyebuchi Erebor , Sukrut Somani, Margaret Mullin, Rothwelle Tate and Christine Dufès, P-256: Synthesis and evaluation of novel targeted hybrid nanocarriers as DNA and drug co-delivery systems for cancer therapy, CRS conference 2017 abstract

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

I wish there were more nanomedicine formulations in the market saving and improving patients' lives for diseases like metastatic cancers and chronic kidney disease.

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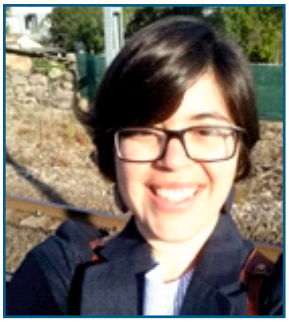
# TANIA HIDALGO

Postdoctoral Researcher of Advanced Porous Material Unit (APMU) at IMDEA Energy
Avda. Ramón de la Sagra, 3, Parque Tecnológico de Móstoles, 28935 Móstoles, Madrid, Spain

@TaniaHIDALGO87



## INTRODUCE YOURSELF

Dr. Tania Hidalgo (H-index:10) has been awarded with the "Atracción del Talento" grant from the Community of Madrid in order to develop her investigation at the Advanced Porous Materials unit in the IMDEA Energy institute (Spain) as Postdoctoral Researcher. Her job is focus in the development of porous materials (Metal-Organic Frameworks, MOFs) for the protection & immobilization of macromolecules (proteins / enzymes / drugs). She has obtained a Joint PhD thesis in Material Chemistry & Pharmacy issued by the University of Versailles (France) and the University of Santiago de Compostela (Spain) under the supervision of Dr. P. Horcajada (H-index:50) and C. Serre (H-index:98), leaders in the MOF field and their bioaplication, together with Prof. M.J. Alonso (H-index:89), internationally recognized galenist. She is a new member of the Young Scientist Committee, looking forward to contribute to the growing science community, meeting with scientists from all over the world. Moreover, she is actively participating in the organization of Pint of Science Spain (firstly in PoS Ireland 2018 as local manager and secondly in PoS Madrid 2019-2020, responsible of Communication department) as well as volunteering with other public engagement activities such as the "European Researchers' Night–Marie Curie Actions", "The Science Week" or "International Day of Women and Girls in Science". For her, to get involved in these dissemination activities will promote future collaborations with leading research groups on different fields, reinforcing and expanding the scientific knowledge by tackling together the fundamental challenges associated with different high-societal concerned severe diseases.

## RESEARCH BACKGROUND

Her PhD project was based on the synthesis and characterization of novel drug delivery systems, the nanoscaled MOFs (nanoMOFs), modulating their fate by external surface modifications with attractive biopolymers depending on the desired administration route. After her PhD, she started her postdoctoral experience with a MedTrain Marie Skłodowska-Curie COFUND Fellowship lead by Prof. Caitriona O'Driscoll (H-index: 35) in UCC (Ireland), aimed at efficient drug delivery platforms for nucleic acid delivery across the blood-brain barrier (BBB).Over the past years, she has acquired experience on the design, characterization and engineering of nanocarriers, working with a variety of therapeutic molecules for both encapsulation and release studies (proteins, peptides, drugs, etc.) as well as she has evaluated the interaction of diverse physiological barriers (intravenous, oral or cutaneous vias), biostability, nanosafety & in vitro efficacy assays. It was in this environment she discovered her enthusiasm for innovating novel methodologies that will stimulate development of research approaches and technologies broadly applicable to problems in human health such as Material science, Nanomedicine or Immunology.

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# THOMAS MOORE

Marie-Curie MINDED Postdoctoral Fellow

Nanotechnology for Precision Medicine
Istituto Italiano di Tecnologia, Via Morego, 30, 16163 Genoa (GE), Italy

@tlmoore_BioNano

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

My interests in Nanomedicine have grown to revolve around understanding the fundamental behaviors of nanoparticles in biological systems, and applying this towards solving bioengineering and drug delivery problems. I am interested in using nano- and microparticle constructs to deliver drugs into the brain. Specifically, I am investigating how immune cells can be used as a carrier to transport particles across the blood—brain barrier to treat neurodevelopmental disorders.

## INTRODUCE YOURSELF

My introduction to the field was during my doctoral studies in the Department of Bioengineering at Clemson University (Clemson, SC, USA) under Prof. Frank Alexis, where I worked on theranostic nanomedicines for delivering drugs to tumors. After my Ph.D. I wanted to deepen my fundamental understanding of how particles interacted with biological systems. From 2014 until 2018, I worked in the BioNanomaterials group of Profs. Alke Fink and Barbara Rothen-Rutishauser at the Adolphe Merkle Institute (Fribourg, Switzerland) studying colloidal stability in complex biological media, protein corona formation on particles, and fundamental interactions of particles with cells. Since December 2018 I have been a postdoctoral fellow in the MINDED program (https://minded-cofund.eu) at the Istituto Italiano di Tecnologia (Genoa, Italy) in the Nanotechnology for Precision Medicine group of Prof. Paolo Decuzzi.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

Research in Nanomedicine has put me in contact with scientists from many different backgrounds – physicists are needed to understand and develop characterization techniques, computational scientists can model and facilitate the prediction or particle behavior in complex systems, materials scientists and chemists are needed to develop new materials, engineers are needed to investigate scalable and reproducible manufacturing, life scientists are needed to understand biological responses to nanomaterials, and clinicians are required to evaluate their real impact. All these pieces in motion make for an inspiring scientific effort. Moreover, this has necessitated communication between these fields and forced a recognition between each others' expertise. I have been really impressed with how scientists of all generations have taken to social media in a positive way. On Twitter, for example, you see people in this field using it as a tool to support each other, and raise awareness and dialogue on important issues.

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

The field of Nanomedicine is at a sort of "coming-of-age" moment. Researchers are starting to re-frame what are the important questions, and trying to identify new ways to move the field forward. Personally, I am really interested in understanding how particles can move from the site of administration and across biological barriers to their intended site of action. To this end, I think it is also critically important to investigate new means of particle transport, as well as continue fundamental research into so-called nano-bio interactions to gain a "big picture" understanding of how particles move through our bodies. Because a lot of the funding at the beginning of this century was focused on cancer research, Nanomedicine has been prioritizing this specific area. However, I think we are seeing more research and commercialization of Nanomedicines targeted towards other pathologies, making this an exciting time to be part of this community as we continue to build and grow towards a new, re-imagined "nano" future.

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# M. N. V. RAVI KUMAR

Professor of Pharmaceutical Sciences,
Texas A&M University, USA

https://research.tamhsc.edu/drugdeliverylab/

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

The Kumar Lab has made seminal contributions to the field of drug delivery, particularly by incorporating ligand-directed nanoparticles that do not compete with endogenous ligands for receptor binding, and as a result, leading to improved nanoparticle uptake and drug bioavailability. These orally administered nanoparticles have shown efficacy in treating a variety of chronic disorders such as diabetes, peripheral neuropathy, cataracts and systemic lupus erythematosus in animal models.

## INTRODUCE YOURSELF

I am the Professor of Pharmaceutical Sciences at Texas A&M University.

## RESEARCH BACKGROUND

The research that my lab conducts involves multidisciplinary projects bridging polymers synthesis, pharmacology, and pathophysiology, with the ultimate goal of translating to human and veterinary disease therapeutics. Prior to joining Texas A&M University, I was the professor of drug delivery (Jan 2008-Oct 2013) at Strathclyde Institute of Pharmacy and Biomedical Sciences, Glasgow UK, and before that an assistant professor (Sept 2003-Dec 2007) at the National Institute of Pharmaceutical Education and Research (NIPER), India.

## CURRENT RESEARCH INTERESTS

Research in the Kumar Lab is geared towards developing innovative approaches that will redefine how oral drug delivery is practiced. The lab is currently focused on developing **a)** bespoke polyesters that improve drug encapsulation, permit optimization of ligand-receptor stoichiometry and targeting, and **b)** non-competitive, receptor-mediated delivery across physiological barriers, such as the intestine. Ligand-directed or receptor-mediated nanoparticle delivery is in many ways similar to target-based drug discovery, as both disciplines generally seek to find a receptor on or inside the cell to which the ligand/drug will bind. The proposed developments in the Kumar Lab can provide flexible and robust new platforms adaptable to a wide range of ligand molecules and their receptor targets. They will additionally give new lease to the delivery a host of encapsulated drugs, most of which otherwise insoluble or poorly bioavailable, and perhaps uncovering in these drugs favorable therapeutic potentials unattainable by traditional delivery methods.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

In addition to the research itself being quite exciting, knowing that carrier systems invisible to naked eye could have enormous impact on human health has changed the way I think about designing my research problems. Rather than thinking purely of chemistry or mechanisms, I also have to factor in the translational potential of my ideas, focusing on the ones that can realistically "leave the lab", and achieve the scale-up and PK/PD necessary for human usage. As a nanomedicine researcher, my goal is to bring formulations as quickly as possible to live animal trials as they tend to offer the most reliable insights into pharmacological and safety profiles. I also utilize the resources of small and large animal facilities at Texas A&M University to the extent that cross-species testing can give me the datasets needed to model formulation efficacy in larger mammals, such as humans.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

R. Ganugula, M. Arora, P. Saini, M. Guada, and M. N.V. Ravi Kumar. Next generation precision-polyesters enabling optimization of ligand-receptor stoichiometry for modular drug delivery. J. Am. Chem. Soc. 139: 7203-7216, 2017. (Cover article)

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

While the academia-led nanomedicine field has engendered extremely revolutionary and creative methods in drug delivery, such accomplishments have seldom resulted in end-user products. This is perhaps due to unrealistic expectations out of the delivery strategies, which seek to do too much given the underlying complexity and limitations of large-scale translation. I think if drug delivery research were to focus on evolutionary advances such as cutting down dose requirements or converting injectable to non-injectable drug formats, there could be much better translation rates.

## OTHER THOUGHTS ON NANOMEDICINE

It is worthwhile to revisit treatment options for conditions such as cancer, vis-à-vis managing it as a chronic condition, rather than seeking an outright cure. There may have been an overemphasis on curative research, as opposed to research that improves the quality of life by using nanoparticles as means to better handle the toxicological profiles of existing drugs, thereby increasing patient adherence and tolerance of the treatment regimens. We are also very quickly giving up on small molecules for biologics. I believe that nanotechnology delivery strategies can maximize the utility of small molecule drugs in a variety of conditions for which we still lack effective treatment options. Such repurposing of small molecules by nanoparticles, I think, will offer relatively quick short to medium-term improvements to disease management, as much more intricate understandings of the disease and cures are being developed in the longer-term.

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# ANA BELOQUI GARCÍA

Université catholique de Louvain
UCLouvain, Brussels, Belgium

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

Exploiting the pathophysiology of the gut towards innovative oral peptide delivery strategies in the treatment of gastrointestinal diseases.

## INTRODUCE YOURSELF

I am a research associate and assistant professor at the Université catholique de Louvain (UCLouvain) at the Louvain Drug Research Institute. I am a group leader in the Advanced Drug Delivery and Biomaterials group focused on the oral delivery of poorly water-soluble drugs/biologicals.

## RESEARCH BACKGROUND

Since the beginning of my thesis in the University of the Basque Country, I was fascinated with the oral route of administration: the preferred, the easiest, the cheapest…and yet the most challenging. I have been working ever since in the development of novel lipid-based nanomedicines for the oral delivery of poorly water-soluble drugs/biologicals. First as a postdoctoral fellow at the UCLouvain in the group of Prof. Véronique Préat, and now as group leader.

## CURRENT RESEARCH INTERESTS

My current research interest is the development of novel nanoparticle-based formulations for the oral delivery of peptides in the treatment of type 2 diabetes mellitus and inflammatory bowel diseases.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

I am convinced that we have not exploited Nanomedicine to its full potential yet, at least in the oral delivery field. This conviction has driven me to search for alternative nanoparticle-based strategies to overcome the limitations of nanomedicines. I was recently awarded with an ERC starting grant (2019) to conduct my project NanoGut on this context.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Xu Y., van Hul M., Suriano F., Préat V., Cani P.D., Beloqui A. Novel strategy for oral peptide delivery in incretin-based diabetes treatment. Gut (2019) [I.F 17.943]. In press

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

Not so long ago, the idea of a drug delivery system for the oral delivery of peptides seemed just an illusion. Last year the first oral glucagon-like peptide-1 (GLP-1) analog has reached the market (semaglutide, Rybelsus®, NovoNordisk), representing a major breakthrough in the oral delivery of peptides. Regardless of the encouraging properties of nanomedicines, they still must demonstrate superiority to standard formulations incorporating functional excipients in oral peptide delivery. I think that is a challenge that nanomedicine will be able to overcome in the near future.

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# SARA NOGUEIRA

PhD student
RNA Formulation & Drug Delivery
BioNTech SE, Mainz, Germany

@sesnogueira

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

My research focuses on the rational development of clinically relevant lipid nanocarriers for mRNA delivery.

## INTRODUCE YOURSELF

I am currently an industrial PhD student, in RNA Formulation & Drug Delivery department, at BioNTech, under academic supervision of Professor Peter Langguth, at Johannes Gutenberg University of Mainz (Mainz, Germany). Recently, I joined the CRS Young Scientist Committee and Focus Group NND.

## RESEARCH BACKGROUND

I received my bachelor's degree in Biology at University of Trás-os-Montes e Alto Douro (Vila Real, Portugal). I graduated from University of Minho (Braga, Portugal) with a master's in Biophysics and Bionanosystems. My master project involved the development of monoolein-based nanoparticles containing BRAF-siRNA for colorectal cancer therapy. In 2015, I joined Max Planck Institute for Colloids and Interfaces (Potsdam, Germany) for an internship focused on biophysical investigation of the interaction between lipid-systems and nucleic acids.

## CURRENT RESEARCH INTERESTS

My scientific interests lie in the rational development of nucleic acids delivery systems for a wide range of therapeutic applications, such as protein therapy, cancer and infectious diseases vaccination. Specifically, my focus is to understand the molecular basis of mRNA-complexes in order to identify criteria for the design of tailored mRNA drugs.

## HOW THE NANOMEDICINE FIELD HAS CONTRIBUTED TO YOUR PROFESSIONAL CAREER

Nanomedicine has the potential to change the treatment paradigm towards an individualized medicine. The possibility to be directly involved in the development of clinically relevant therapies drove me to do a PhD in translation research in industry.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Ziller, A., Nogueira, S. S., Hühn, E., Funari, S. S., Brezesinski, G., Hartmann, H., ... & Langguth, P. (2018). Incorporation of mRNA in lamellar lipid matrices for parenteral administration. *Molecular pharmaceutics*, 15(2), 642-651.

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# MARIA A. CROYLE

Glaxo Wellcome Endowed Professor of Pharmaceutics
Faculty Advisor, Rho Chi Honor Society, Nu Chapter
Department of Molecular Pharmaceutics and Drug Delivery
The University of Texas at Austin
College of Pharmacy, 2409 W University Ave, PHR 4.214d
Austin, TX 78712

www.croylelab.com

## INTRODUCE YOURSELF

I am a licensed pharmacist and the Glaxo Wellcome Professor of Pharmaceutics at the University of Texas at Austin College of Pharmacy. Prior to coming to UT Austin in 2000, I completed a NRSA post-doctoral fellowship for training in gene therapy at the University of Pennsylvania's Institute for Human Gene Therapy.

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

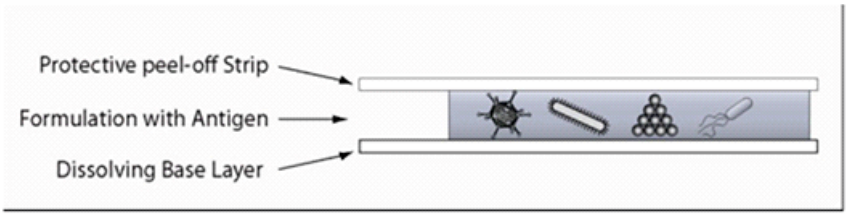
The primary focus of my research involves development of novel methods to stabilize and deliver live viruses and other biological medicines for gene medicine and immunization applications and to understand how viruses and other pathogens impact human health and disease.

## SELECT YOUR BEST PAPER IN NANOMEDICINE

Most recently, my group has developed a novel way to stabilize live viruses in a peelable film matrix. We published these findings in the March 4 issue of Science Advances this year:

Bajrovic, I, Schafer, S.C., Romanovicz, D. and Croyle, M., Novel technology for storage and distribution of live vaccines and other biological medicines at ambient temperature, 2020 *Sci. Adv.* 6(10):eaau4819. doi: 10.1126/sciadv.aau4819.

This technology was developed as part of an international effort to develop a cost-effective needle free Ebola vaccine. Although I have worked in nanomedicine throughout my entire career, it was through this project that I and my team realized that current progress (and those in the near future) of nanomedicines will significantly impact global access to life saving medicines as we make strides in thermostabilization technologies that not only minimize the need for strict temperature regulation but also can be stored and shipped in small spaces as we truly begin to move toward manufacturing on the nanoscale.



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# SOUMYA BENHABBOUR

Assistant Professor at the UNC_NCSU Joint Department of Biomedical Engineering
Adjunct Assistant Professor at the UNC Eshelman School of Pharmacy, Division of Pharmacoengineering and Molecular Pharmaceutics.

## DESCRIBE YOUR RESEARCH/WORK IN NANOMEDICINE

Dr. Benhabbour's academic research focuses on development of novel tunable delivery platforms and polymer-based devices to treat or prevent a disease. Her work combines the elegance of organic and polymer chemistry with the versatility of engineering and formulation development to design and fabricate efficient and translatable nanocarriers and drug delivery systems for cancer treatment and HIV prevention.

## INTRODUCE YOURSELF

S. Rahima Benhabbour is an Assistant Professor at the UNC_NCSU Joint Department of Biomedical Engineering and an Adjunct Assistant Professor at the UNC Eshelman School of Pharmacy, Division of Pharmacoengineering and Molecular Pharmaceutics. After completing her doctorate degree in chemistry in 2008 at McMaster University in Canada, Benhabbour completed a postdoctoral fellowship at the UNC Eshelman School of Pharmacy and was promoted to a Research Assistant Professor in December 2010. In September 2017, she was hired as a tenure-track Assistant Professor at the UNC_NCSU Joint Biomedical Engineering Department with an Adjunct Appointment at the UNC Eshelman School of Pharmacy. Dr. Benhabbour has also Founded her startup company Anelleo, Inc. (AnelleO) in 2016 to develop the first 3D printed intravaginal ring as a platform technology for women's health.

## CURRENT RESEARCH INTERESTS

Current technologies in development in Dr. Benhabbour's Lab include:
·3D Printed intravaginal ring technology: A) Multipurpose technology (MPT) for prevention of HIV/STIs and unplanned pregnancy.
·Polymer based ultra-long-acting injectable implant for HIV prevention and treatment.
·Combinatory chitosan/cellulose nanocrystals thermoresponsive hydrogel system: A) Sub-Q or intraosseous injectable for treatment of osteoporosis; B) Bio-ink for 3D bioprinting; C) Scaffold for stem cell delivery (e.g. iNSCs for treatment of post-surgical glioblastoma.
·Mucoadhesive thin film for treatment of vulvodynia.
·Targeted nanoparticles and hydrogel scaffolds for treatment of NSCLC.
My previous work in nanomedicine focused on the development of targeted lipid-based nanoparticles (NPs) for treatment of primary and metastatic NSCLC (J. Control. Release, 2012). In this work, I discovered a way to significantly enhance drug entrapment and in vivo efficacy (Int. J. Nanomed., 2011; Cancer Lett., 2012; Adv. Healthcare Mat., 2013; Nanomedicine, 2014; Int. J. of Nanomedicine, 2014). We have also implemented new and effective targeting modalities to enhance tumor uptake of the nanocapsules using CD44 monoclonal antibodies and ultrasound-mediated delivery (Mol Pharmaceutics, 2016, Mol Pharmaceutics, 2018). My current research interests in the field of nanomedicine are focused on engineering cellulose nanocrystals-chitosan based hydrogel scaffolds for sustained delivery of stem cells for treatment of glioblastoma and for bone tissue engineering.

## YOUR OPINION/VIEW ON THE CURRENT PROGRESS OF THE FIELD

Recent advances in nanomedicine include use of nanocarriers to enhance delivery of CRISPR-Cas9 into the cells; LbL nanoassemblies for delivering therapeutic siRNA; and nanoparticles for cancer immunotherapy. There are a number of exciting reports on harnessing nanotechnologies as delivery vehicles and for a wide range of applications. Main challenges remain in enhanced efficacy of targeted nanocarriers and their translation into the clinic.