Fellowship Year Reflections

Tram Dang

Background
I completed my Ph.D. in chemical engineering in the laboratories of Prof. Robert Langer and Prof. Daniel Anderson at Massachusetts Institute of Technology, U.S.A. During my graduate training, I developed new noninvasive imaging techniques to investigate the effects of controlled release anti-inflammatory drugs on the immunological response to biomaterials and applied the findings to enhance cell-based therapeutics for diabetes therapy.

In September 2012, with the support of the Sung Wan Kim postdoctoral fellowship from the CRS Foundation, I joined the laboratory of Prof. Ali Khademhosseini at Brigham and Women's Hospital, Harvard Medical School. I was excited to play an important role in a multidisciplinary collaboration to develop new technologies for chronic wound management. The Sung Wan Kim Postdoctoral Fellowship gave me a wonderful opportunity to explore different aspects of a new medical challenge while capitalizing on my expertise in drug delivery to contribute to this emerging area of research.

***Tram Dang** (pictured far left) receiving her fellowship from Sung Wan Kim and Foundation Chair Susan Cady at the 2012 CRS Annual Meeting & Exposition.*

Scientific Significance and Achievements
Chronic wounds are a major medical burden, imposing staggering costs on the health care systems in both developed and developing countries. For example, in the United States alone, chronic wounds affect about 6.5 million people, costing the country $20 billion annually in health care expenditure. These wounds are tissue injuries that fail to progress in an orderly and timely fashion, resulting in impaired healing. Underlying pathological conditions such as pressure ulcers, venous ulcers, diabetic foot ulcers, and their associated infection are often involved. Patients who are particularly vulnerable to chronic wounds include the elderly population and individuals suffering from diabetes or impaired mobility because of strokes and spinal cord injuries.

The wound microenvironment is biologically complex and dynamic, involving various cell types and a continuously changing level of cytokines and enzymes. Despite our growing understanding of wound healing biology, successes from different wound treatment therapies such as electrical stimulation, oxygenation, or delivery of cells and growth factors remain limited. A major shortcoming associated with such systems is their systemic and open-loop nature. There is no physical, chemical, or biological feedback mechanism to adjust the treatment in response to the changing microenvironment of the wounds.

Thanks to the generous support of the Sung Wan Kim Postdoctoral Fellowship, I had the opportunity to join a multidisciplinary team of scientists in Prof. Khademhosseini's laboratory at Harvard Medical School to address this pressing challenge in chronic wound therapy. Our project is a multiuniversity collaboration to combine the expertise in biomaterials, drug delivery, and microfabrication from our team at Harvard Medical School with the electrical engineering strengths in flexible electronics from our collaborators at Tufts and Purdue Universities. We aim to revolutionize chronic wound treatment by developing a flexible smart-dressing platform that integrates multiple sensing capabilities and treatment modalities for active intervention in the wound microenvironment. Specifically, we envision that this dressing can adjust therapeutic treatment in response to changing physical, chemical, and biological parameters in the wound microenvironment, such as temperature, mechanical stress, and oxygen and pH levels.

I am particularly interested in the dynamic biological signals at the wound sites. During the different phases of the wound healing process, some inflammation is necessary for recruitment of various immune cells, which secrete cytokines and growth factors to modulate the progress of healing. However, excessive inflammation can impede healing or lead to extensive fibrotic deposition and scar formation. For example, overgranulation, a condition of excessive growth of collagen and new blood capillaries, often impedes the migration of epithelial cells, hinders wound closure, and increases the risk of infection.

To address this challenge, I proposed an innovative drug delivery system to be integrated into the smart-dressing platform and release anti-inflammatory therapeutics in response to the varying inflammatory signals at the wound sites. To achieve this goal, I synthesized and characterized a new inflammation-responsive hydrogel material conjugated with small-molecule anti-

inflammatory drugs via peptide linkers. The key advantage of this system is that the linkers can be cleaved by inflammatory proteases, which are secreted by inflammatory cells present at the wound sites. Therefore, the amount of drug released from this hydrogel material is dependent on the concentration of inflammatory proteases in the wound microenvironment. In the future, we plan to integrate this new material into our smart-dressing platform and evaluate its performance in an animal model of chronic wounds.

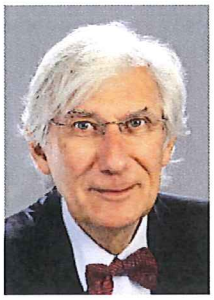
In addition to addressing exciting problems in chronic wound therapy, the Sung Wan Kim fellowship also allowed me the flexibility of working on many collaborative projects in other exciting research areas at Harvard Medical School. In the past year, these collaborations have resulted in one publication in the journal *Advanced Materials* on the topic of microengineered and mechanically tunable hydrogels and a book chapter on the subject of polymeric biomaterials for implantable prosthetics.

Professional Development

As the Sung Wan Kim fellow, I also had many opportunities for professional networking and for contributing to the controlled release community. During my fellowship year, I began to serve as an independent reviewer for the *Journal of Controlled Release* and an abstract reviewer for the 2013 CRS Annual Meeting. Currently, I am also excited to be involved in the launching of a new CRS Local Chapter for the Southeast Asia region.

I truly appreciate the CRS Foundation and its generous contributors who have given me a wonderful opportunity to broaden my scientific training and career development. I am honored to serve as the Sung Wan Kim fellow in the past year. In the future, I plan to remain an active member of the Controlled Release Society to contribute to the progress of the controlled delivery field. I am also grateful to Prof. Sung Wan Kim and my Ph.D. and postdoc advisors for their continuous support of my scientific endeavors. ■

2014 Alexander Florence Postdoctoral Fellowship



Alexander Florence

In 2014 the CRS Foundation will give a $30,000 postdoctoral fellowship named to honor CRS past president Alexander "Sandy" Florence, former dean and current emeritus professor of the School of Pharmacy, University of London. He is editor-in-chief (Europe) of the *International Journal of Pharmaceutics* and was founding coeditor of the *Journal of Drug Targeting*. Author of hundreds of papers and multiple books, and recipient of numerous awards, Prof. Florence's expertise in pharmaceutical nanotechnology, drug delivery systems, physical pharmaceutical chemistry, novel dendrimers, and surface chemistry has added greatly to drug delivery research.

Build the Endowment

The CRS Foundation Board is focusing its 2013 time and resources to build the endowment for future sustainability. Your contribution matters. Please help build the endowment and support the next postdoctoral fellowship by making a generous year-end donation on the CRS Foundation website, www.controlledreleasesociety.org/about/foundation.

Celebrate the Advances

Thanks to the generosity of CRS members and the delivery science community, the CRS Foundation has awarded postdoctoral fellowships of $30,000 each to four exceptional young delivery scientists since 2009. With each fellowship, CRS honors exemplary delivery scientists and supports the training of its future leaders.