BIOEN 509 – DEPARTMENTAL SEMINAR SERIES

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Seeing cancer: From super-resolution microscopy to multi-modality optical imaging in vivo

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Optical imaging has been an indispensable tool in biomedical research. However, image resolution is limited by the fundamental wave nature of light and this limitation has been a major challenge in probing fine biomolecular structures. I will describe the development of super-resolution microscopy based on the application of standing waves (SW) with total internal reflection geometry and surface plasmon resonance (SPR) to amplify signals by electromagnetic field enhancement. The combination of these two modalities resulted in a novel high-resolution microscopic technique, standing-wave surface plasmon resonance fluorescence (SW-SPRF) microscopy. I will describe the application of SW-SPRF for wide-field super-resolution imaging. In addition, as an example of the utilization of novel optical technologies for detecting and imaging complex cellular behavior in vivo, I will illustrate the use of advanced optical imaging modalities to reveal the pathophysiology of cancer and metastases. High-speed two-photon imaging and a secreted Gaussia luciferase-based assay have enabled us to identify and track tumor metastases and monitor their response to treatment. This interdisciplinary approach provides fundamental insight into tumor biology and the development of translational therapeutic strategies.

After receiving B.S. and M.S. degrees from Korea Advanced Institute of Science and Technology, Dr. Chung earned his PhD from the Harvard-MIT Division of Health Sciences and Technology (HST) Medical Engineering and Medical Physics program in 2007. His work involved in the invention of super-resolution microscopy techniques utilizing evanescent SW and SPR. While in graduate school, he helped a biotechnology start-up company, Nanopoint Inc., as a technical consultant for the development of high-resolution imaging system based on his thesis work. In addition, he also worked for a medical venture company, Cambridge Devices Inc., to develop polarization-based fluorescence imaging for skin cancer margin detection to guide surgeons. Since then he joined the Steele laboratory (Prof. Rakesh K. Jain) at Harvard Medical School to pursue translational cancer research as a postdoctoral fellow. Currently he focuses on improving the treatment of breast cancer metastasis to the brain which is uniformly fatal using preclinical models. He developed novel two-photon microscopes and molecular imaging strategies to trace the events of cancer metastasis and subsequent growth with angiogenesis. His career is devoted to creating translational imaging technologies beyond proof-of-principle prototypes based on a thorough understanding of the biological context and clinical needs.

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