Michael Kolios, Ph.D.

BIOENGINEERING
Spring 2019 Seminar

Date: **Thursday, March 28, 2019**
Time: **12:00 pm - 1:00pm**
Location: **Krasnow, Room K229**

Biography: Dr. Michael C. Kolios is Professor in the Department of Physics at Ryerson University and Associate Dean of Research and Graduate Studies in the Faculty of Science. His work focuses on the use of ultrasound and optics in the biomedical sciences. His laboratory houses state-of-the-art ultrasound and photoacoustic tools using frequencies ranging from 1 to 1000 MHz to study the interaction of ultrasound and light with biological materials for imaging and therapy. Dr. Kolios leads a large group of projects that focus on optical and ultrasound methods used to characterize tissues and disease, as well as to develop theranostic agents that will assist in both therapeutic and diagnostic applications. To date, he has published over 100 peer-reviewed journal publications, 5 book chapters and 132 papers in conference proceedings. He has been invited to speak at many different organizations/conferences and has been the keynote and plenary speaker for conferences in Canada, India, and China. Dr. Kolios has received numerous teaching and research awards, including the Canada Research Chair in Biomedical Applications of Ultrasound, the Ontario Premiers Research Excellence Award, and the Ryerson Faculty Teaching Award. In 2016 received the American Institute of Ultrasound in Medicine (AIUM) Joseph H. Holmes Basic Science Pioneer Award for significant contributions to the growth and development of medical ultrasound and in 2017 was elected to the College of Fellows for the American Institute for Medical and Biological Engineering (AIMBE). He is on the editorial board of the journals Ultrasound Imaging and Photoacoustics and is a member of many national and international committees, including the IEEE International Ultrasonics Symposium Technical Program Committee. He was a charter member of the National Institutes of Health (NIH) Biomedical Imaging Technology A study section and a member of the College of Reviewers for the Canadian Institutes of Health Research (CIHR).

Title: Nanobubbles for ultrasound and photoacoustic molecular imaging

Abstract: Ultrasound imaging contrast agents are typically lipid, polymer or protein-stabilized gas particles with diameters in the range of 1-2 microns. These agents are highly echogenic due to the acoustic impedance mismatch between the gas particle and the surrounding fluid, bubble oscillations close to their resonance frequency, and the nonlinear oscillation modes that they can be sustained when exposed to ultrasound. However, these commercial agents have restricted applicability in molecular imaging, as their size confines the microbubbles to the vasculature. The size restricts their targetability to markers that are expressed primarily within the intravascular space. Recently gas particles with lipid or polymeric shells have been created which have sizes that are an order of magnitude smaller than the current commercial microbubbles (100-200 nm). This size allows, in principle, the rapid extravasation of nanobubbles through leaky vasculature - and therefore enables interactions with markers that are expressed outside the vasculature and in the tissue / tumor parenchyma. The nanobubble small size, size selectivity, and long half-life make them well suited for molecular imaging using contrast-enhanced ultrasound. Highly absorbing chromophores can be inserted in the nanobubble shell, allowing the same nanobubbles to be used photoacoustic contrast agents (or even therapeutic agents). In this presentation, an overview will be given of the current understanding of the interactions of the nanobubbles with ultrasound. Explanations will be provided for the enigmatic high nanobubble echogenicity at clinical ultrasound frequencies using nonlinear scattering models that take into account bubble-bubble interactions and multiple scattering. Results from the use of nanobubbles in applications for which a leaky vasculature is a prominent feature (tumors, inflamed tissues) will be presented and discussed, and compared to similar experiments with microbubbles. These nanobubbles can be used to probe the tumor microenvironment in ways that could not be achieved by ultrasound before and are very well suited as molecular imaging contrast agents.

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