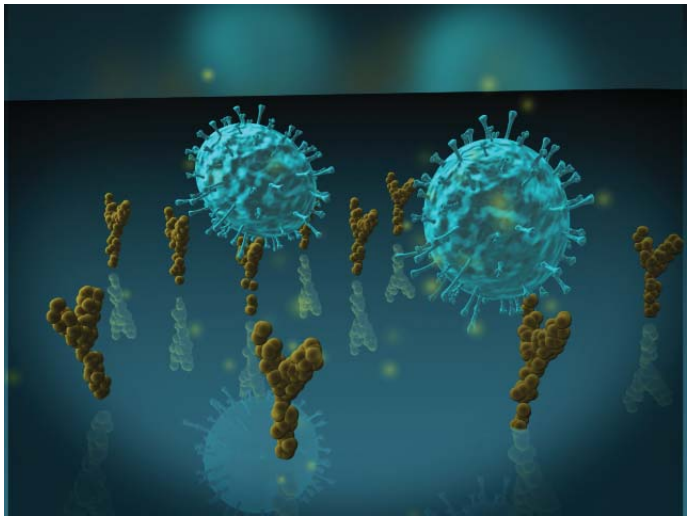
The Institute of OPTICS

Colloquium

UNIVERSITY OF ROCHESTER

Optical Interference for multiplexed, label-free, and dynamic biosensing: protein, DNA and single virus detection



Professor M. Selim Ünlü
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3:00 pm, Monday, Feb 28, 2011
Sloan Auditorium, Goergen 101
Refreshments provided.

This talk will describe the IRIS sensor which uses optical interferometry for label-free, high throughput high-sensitivity and dynamic detection of molecular binding on a solid surface.

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Professor M. Selim Ünlü, Boston University

DIRECT monitoring of primary molecular binding interactions without the need for secondary reactants would markedly simplify and expand applications of high-throughput label-free detection methods. The Interferometric Reflectance Imaging Sensor (IRIS) was developed at the Boston University Photonics Center and uses optical interferometry for label-free, high throughput, high sensitivity and dynamic detection of molecular binding on a solid surface. IRIS has demonstrated protein-protein binding and DNA-protein binding in real time, label-free, and in a high-throughput format with exquisite sensitivity (~10 pg/mm^2) and reproducibility [1,2] as well as label-free measurements of DNA hybridization kinetics. We have significantly advanced IRIS beyond the original tunable-laser configuration and implemented a multi-LED discrete wavelength system that allows for high spatial resolution imaging with the demonstrated ability to detect single nanoscale particles [3]. To detect and size pathogens, IRIS shines light from multi-color LED sources sequentially on nanoparticles bound to the sensor surface, which consists of a silicon dioxide layer on top of a silicon substrate. Interference of light reflected from the sensor surface is modified by the presence of particles producing a distinct signal that reveals the size of the particle. We have successfully detected 35 nm and 50 nm radius particles and H1N1 viruses (illustrated in the conceptual picture) with accurate size discrimination [3]. The device has a very large surface area and can capture the telltale interferometric responses, in parallel, of up to a million nanoparticles. Size discrimination allows for reducing the noise resulting from many smaller particles that may be present in the target solution that may bind to the sensor indiscriminately. IRIS has a great advantage in that we can employ both polarization and pupil function engineering to characterize the shape, size and orientation of particles with resolution beyond the classical diffraction limit.

M. Selim Ünlü is a Professor of Electrical and Computer Engineering, Biomedical Engineering, and Physics at Boston University. He is also serving as the Associate Dean for Research and Graduate Programs as well as the Associate Director of Center for Nanoscience and Nanobiotechnology. Prof. Ünlü received the B.S. degree in electrical engineering from Middle East Technical University, Ankara, Turkey, in 1986, and the M.S.E.E. and Ph.D. in electrical engineering from the University of Illinois, Urbana-Champaign, in 1988 and 1992, respectively. Since 1992, he has been on the faculty at Boston University.

Dr. Ünlü's career interests are in the areas of nanophotonics and biophotonics. Currently, he is working on high-resolution solid immersion lens microscopy of semiconductor devices and circuits, as well as biosensor fabrication and development of biological imaging techniques, particularly in high-throughput, label-free microarrays. He was awarded National Science Foundation Research Initiation Award in 1993, United Nations TOKTEN award in 1995 and 1996, and both the National Science Foundation CAREER and Office of Naval Research Young Investigator Awards in 1996. He has authored and co-authored over 250 technical articles and several book chapters and magazine articles; edited one book; and holds several patents. His professional service includes the former chair of *photodetectors and imaging,* founding chair of *Nanophotonics*, and current chair of *Biophotonics* technical committees for IEEE Photonics Society, and Editor-in-Chief for *IEEE Journal of Quantum Electronics*. Dr. Ünlü has been selected as an IEEE Photonics Society *Distinguished Lecturer* for 2005-2007 and Australian Research Council Nanotechnology Network (ARCNN) *Distinguished Lecturer* for 2007. He has been elevated to IEEE *Fellow* rank in 2007 for his *contributions to optoelectronic devices.* In 2008, he was awarded the Science Award by the Turkish Scientific Foundation.