

**CORE-CM SEMINAR**  
**Michigan State University**

**Dr. Vladimir Bulović**  
**M.I.T., Organic & Nanostructured Electronics Laboratory**

*Colloidal Quantum Dots in Efficient LEDs and Displays*

The high luminescence efficiency and uniquely size-tunable color of semiconducting colloidal quantum dots (QDs) led to the recent commercial use of QD phosphors in energy-efficient lighting and high-color-quality displays. Since the optically-excited QD solutions and films show a narrow spectral emission with long-term stability, and since they can be processed as films of nanoscale thickness, this suggested their use in electrically-excited p-i-n LED structures of highly saturated color. Over the last decade several types of QD-LEDs have been developed with steadily improving performance, with the latest devices demonstrating external quantum efficiencies (EQE) of >18%, corresponding to the internal quantum efficiencies of >90%. For these devices, brightness in excess of 50,000 cd/m<sup>2</sup> has been reached at operating voltages of only a few volts, and turn on voltages just below the QD bandgap energy/q. Our experiments demonstrate efficient QD-LED performance across the visible spectrum and into the near IR, exceeding the EQE of any other planar-emitting technology at emission wavelengths beyond 1µm. As the present visible QD-LED efficiencies approach those of already-commercialized molecular organic LEDs, the talk will catalog the key scientific and technology challenges facing QD-LED commercialization as a display technology and will offer outlook on the ongoing strategies to overcome these challenges.

Vladimir Bulović is the Professor of Electrical Engineering at MIT, holding the Fariborz Maseeh Chair in Emerging Technology, leading the Organic and Nanostructured Electronics laboratory, directing the MIT Microsystems Technology Laboratories and co-directing the MIT-ENI Solar Frontiers Center. Bulović's research interests include studies of physical properties of organic and organic/inorganic nanocrystal composite thin films and structures, and development of novel nanostructured optoelectronic devices. He is an author of over 150 research articles (cited over 10,000 times) and an inventor of over 55 U.S. patents in areas of light emitting diodes, lasers, photovoltaics, photodetectors, chemical sensors, programmable memories, and micro-electro machines, majority of which have been licensed and utilized by both start-up and multinational companies. He is a founder of QD Vision, Inc. of Lexington MA which is producing quantum dot optoelectronic components, of Kateeva, Inc. of Menlo Park CA which is focused on development of printed organic electronics, and Ubiquitous Energy, Inc. which is developing nanostructured solar technologies. Prof. Bulović received his M.S. Degree from Columbia University in 1993 and his Ph.D. from Princeton University in 1998. He is a recipient of the U.S. Presidential Early Career Award for Scientist and Engineers, the National Science Foundation Career Award, the Ruth and Joel Spira Award, Eta Kappa Nu Honor Society Award and the Bose Award for Distinguished Teaching, he was named to Technology Review TR100 List, and in 2012 he shared the SEMI Award for North America in recognition of his contribution to commercialization of the quantum dot technology. In 2008 he was named the Class of 1960 Faculty Fellow in recognition of his contribution to Energy Education, in 2009 he was awarded the Margaret MacVicar Faculty Fellowship, MIT's highest teaching honor, and in 2011 he was named the Faculty Research Innovation Fellow for excellence in research and international recognition.

**Thursday, October 17, 2013**  
**12:00 PM**  
**Room 1400 – BPS**  
**Professor Richard Lunt – Host**