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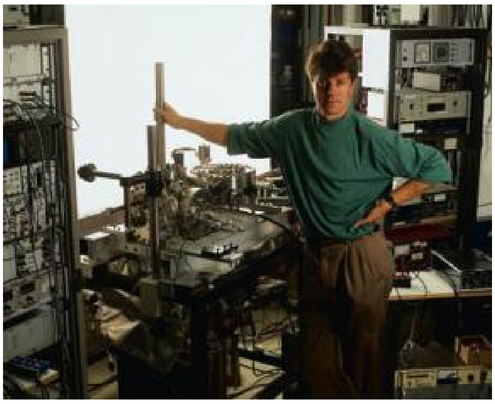

Dr. Mathew B. Johnson
Physics and Astronomy/Engineering Physics
University of Oklahoma

Fun with Interdisciplinary Nanoscience

Time & Date: 11:30am-12:30pm, Wed. November 28, 2012
Location: EME 1203, UBC Okanagan campus

Talk Abstract: In this talk, I will describe three interdisciplinary projects related to my work on fabrication, characterization, and applications of nanostructures. Then I will conclude with some recent developments in nano-characterization. The first nanofabrication project bypassed conventional photo- and e-beam lithographic techniques and instead used self-assembled nanoporous materials. For over a decade, we have been using ultra-thin anodic aluminum oxide (AAO), as templates for deposition and etching masks to fabricate a wide variety of ordered arrays of nano-dots, holes, and rings. Our most recent work (in collaboration with R. Frech, a chemist) is on nano-confined polymer electrolytes for nano-integrated batteries, fuel cells, capacitors and displays. Specifically we have demonstrated a two orders-of-magnitude improvement in ionic conductivity in the confined structures relative to that of bulk films. The enhanced conductivity is the result of polymer ordering due to confinement and may lead to improved fuel cell and lithium battery performance.

The second project uses nanotechnology for biological study. Specifically we use beadlithography as an inexpensive technique to fabricate hexagonal patterns with repeat spacing from about 0.1 to 5 m. In collaboration with D.W. Schmidtke (a bioengineer), we use this method to pattern a wide range of proteins to fabricate biomemetic surfaces. Then using motion capture cameras on the micron scale we video the rolling and spreading of cells on these artificial capillary walls. Our goal is to better understand the role of these cells in the tissue healing process.

The third project in collaboration with R.Q. Yang (an electrical engineer) and M.B. Santos (a crystal grower) uses conventional nanofabrication techniques to fabricate interband cascade (IC) lasers. IC lasers are similar to quantum cascade (QC) lasers; however they use interband cascade rather than intersubband cascade transitions. These lasers are sufficiently efficient that they were/are the preferred mid-IR laser for extra-terrestrial applications, such as methane and water sensing on Mars. These efficient mid-IR lasers will have many chemical sensing applications from remote sensing to handheld devices.

My talk will conclude with new developments in nanoscale characterization techniques, specifically with our dual beam field-emission scanning electron microscope (FE-SEM) / focused ion beam (FIB). In crystalline materials the FE-SEM, with appropriate detectors, allows us to observe atomic steps and crystalline defects as observed with AFM or TEM, respectively. Furthermore, the FE-

SEM, in combination with FIB etching, allows sources of crystalline defects to be explored in much less time than using conventional cross-sectional TEM.

Speaker Biography: Dr. Matthew B. Johnson received the B.S. degree in physics from the University of Waterloo, Waterloo, ON, Canada, and the Ph.D. degree in applied physics from the California Institute of Technology, Pasadena, in 1979 and 1989, respectively. He has been a Physics Faculty Member with the University of Oklahoma, Norman, since 1995. He previously held post-doctoral positions with IBM Research, Yorktown Heights, NY, and IBM Research, Zürich, Switzerland. He has been serving as the Director of the Center for Semiconductor Physics in Nanostructures, National Science Foundation Materials Research Science and Engineering Center with members at the University of Oklahoma, and the University of Arkansas, Fayetteville, since 2000. He has co-authored over 100 scientific publications.

For further information please contact:
Jonathan Holzman (Email: jonathan.holzman@ubc.ca)