

Carnegie Mellon

Materials Science and Engineering Seminar Series

Doug Natelson

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Rice University

*“Single-molecule Electronics: Physics, Physical Chemistry, and
Materials Science”*

Friday, November 9, 2007

11:00 A.M. Seminar in the Singleton Room, Roberts Hall 4th

The transistor, the basis for modern electronics, is the electronic analog of a valve, with current flow between source and drain electrodes modulated by the voltage applied to a third "gate" electrode. It is now possible to make transistors where the active region is a single small molecule, and current passes through individual quantum states of the molecule. Single-molecule transistors (SMTs) are excellent tools for studying the atomic-scale limits of electronic conduction. I will review how these structures are made and how the very small size of these systems brings out materials physics and chemistry that is not relevant in larger devices. One overarching problem in working at these scales is the inability to see or infer the detailed device configuration (e.g., where is the molecule, and how is it oriented between the electrodes?). I will report recent exciting progress in overcoming this problem, with implications for sensing applications.

Douglas Natelson is an associate professor in the Department of Physics and Astronomy at Rice University. Originally from Pittsburgh, he received a B.S.E. in mechanical and aerospace engineering from Princeton in 1993 and a Ph.D. in condensed matter physics from Stanford in 1998. After two years as a postdoc at Bell Labs, he joined the Rice faculty in 2000. His research group focuses on experimental condensed matter physics at the nanoscale. He has published recent papers on organic semiconductor devices, atomic- and molecular-scale electronics, and quantum coherence effects in metal nanostructures. Prof. Natelson is a member of the APS and the MRS. He received the Research Corporation's Research Innovation Award, an Alfred P. Sloan Foundation research fellowship, a David and Lucille Packard Foundation fellowship, and a CAREER award from the National Science Foundation.