MECHANICAL ENGINEERING DEPARTMENT
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THERMODYNAMICS AND HEAT TRANSFER DEPARTMENT SERIES
Topic: PLASMA TECHNOLOGY
Host: Joachim V.R. Heberlein

Nanodusty Plasmas: New Opportunities for "Old" Technologies

by

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Wednesday, February 1, 2006
3:30-5:00 p.m.
Room 1130 ME
Coffee and refreshments will be available at 3:15 p.m. in Room 1130 ME before the seminar

ABSTRACT — Since the late 1970s, the semiconductor industry has relied on plasma processing as a key enabling technology, which, however, is now widely considered as "mature." With the emergence of nanotechnology other properties of plasmas are claiming a place in the spotlight. The ability of reactive plasmas to form nanoparticles was initially known as a contamination problem in semiconductor manufacturing. In this seminar, however, it is demonstrated that plasmas can be used as efficient sources of functional nanoparticles.

Two examples of this approach are presented. First, a constricted mode capacitive discharge is used to produce single-crystal, cube-shaped silicon nanoparticles. Particles are between 20-50 nm in diameter with a highly monodisperse particle size distribution. Applications of these particles in the manufacture of nanoparticle-based Schottky barrier vertical transistors are presented. Second, a high-yield plasma process is used to form silicon quantum dots in a single-step flow-through reactor. The silicon nanoparticles are less than 5 nm in size and exhibit intense room temperature photoluminescence. Unusually high quantum efficiencies for silicon have been achieved through surface passivation under strict exclusion of oxygen.

BIO — Uwe Kortshagen is Professor in the Department of Mechanical Engineering of the University of Minnesota and a member of the graduate faculty of the Department of Physics. He is Director of the NSF-IGERT program for Nanoparticle Science and Engineering and serves as Director of Graduate Studies for the Minor in Nanoparticle Science and Engineering. He earned his Diploma degree in Plasma Physics in 1988, and his Ph.D. in Plasma Physics in 1991 from the University of Bochum, Germany. He came to the U.S.A. in 1995 with an Alexander von Humboldt Fellowship and spent a year in the Dept. of Physics at the University of Wisconsin-Madison. He was awarded the Habilitation in Experimental Physics at the University of Bochum in 1995. In 1996 he joined the University of Minnesota as Assistant Professor where he was promoted to Associate Professor in 1999, and to Full Professor in 2003. He was recently elected Vice-President of the International Plasma Chemistry Society, and was awarded the 2005 Institute of Technology-George Taylor Award for Distinguished Research of the University of Minnesota.

Informal Faculty Luncheon: Wednesday, February 1, 2006, 12:00 noon. Meet in 1100 ME and walk to lunch with other faculty. Prof. Kortshagen will be able to attend.