

Spring 2011 COURSE ANNOUNCEMENT
PHYS 499M (cross-listed as ENMA 489X)

**Special Topics in Physics and Engineering Materials: Physics, Material
Chemistry and Device Applications at the Nanoscale**

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Class Day & Time: Tuesday, 2 to 5 P.M. (in regular lecture weeks class will only take 1-1.5hrs).

Prerequisites: Basic knowledge of quantum mechanics (e.g. PHYS270 level or equivalent) is preferred. Basic knowledge of introductory chemistry is also recommended (**but not required**).

Course Description: This course is designed for advanced undergraduates and graduate students in physics, chemistry and engineering with interest in the evolving interdisciplinary field of nanoscience and nanotechnology. It will emphasize on both fundamental principles (physics and chemistry) at the nanoscale and bench-top nanoscale experimental techniques including nanomaterial synthesis, characterization and simple nanodevice fabrications. Students will have opportunities to quickly learn foundations and exciting advances of the field.

Course Organization: Lectures and Five/Six Experimental Projects. Students will be evaluated at several levels: (1) 15mins oral presentation in the end of semester; (2) final term paper; (3) class performance (including labs);

Course Outline (Tentative):

Section 1:

- (1) Size matters– the fundamental physics behind nanotechnology
- (2) Physics and examples of 0D system: molecules and quantum dots
- (3) Physics and examples of 1D system: nanowires, nanotubes and nanobelts
- (4) Physics and examples of 2D system: quantum wells and graphene

Section 2:

- (5) Nanoscale characterization: state-of-the-art imaging and spectroscopic techniques.
- (6) Top-down Nanoscale fabrication, including nanolithography.
- (7) Bottom-up Nanoscale synthesis, including self-assembly and nanomaterial synthesis

Section 3:

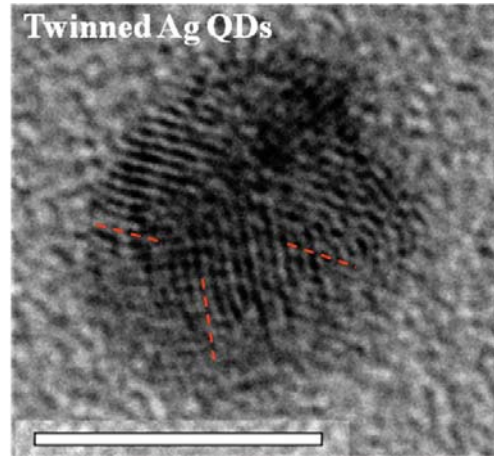
- (8) Application-1: nanoelectronics
- (9) Application-2: quantum computation and spintronics
- (10) Application-3: nanophotonics (including nanoplasmonics)
- (11) Application-4: nanobiotechnology

Section 4:

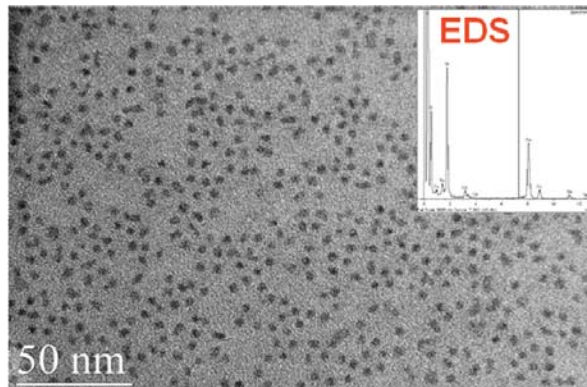
- (12) Experiment 1: synthesis of Ag/Au nanoparticles;
- (13) Experiment 2: synthesis of CdSe semiconductor quantum dots;
- (14) Experiment 3: fabrication of nanopore structures;
- (15) Experiment 4: synthesis of magnetic nanowires;
- (16) Experiment 5: organic light emitting diodes
- (17) Experiment 6: Electron microscopy characterization of as-made nanomaterials

Selected Lab Results Achieved by Students from Former Semesters:

- Metallic Silver Quantum Dots –unique surface Plasmon resonance



- Semiconductor CdSe Quantum Dots – manifestation of quantum confinement effect



- One- Dimensional Magnetic Nanowires – manifestation of nanomagnetism and anisotropic effect

