Applied Science and Technology

College of Engineering (<u>http://</u>

<u>coe.berkeley.edu</u>) Group Office: 210 Hearst Memorial Mining Building, (510) 642-0449

Graduate Group Website: Applied Science and Technology (<u>http://coe.berkeley.edu/ast</u>)

Overview

This graduate group is administered by the College of Engineering, Materials Science and Engineering Department. The program has three major areas of emphasis: applied physics, engineering science, and mathematical sciences. Faculty associated with the program are drawn from several departments within the College of Engineering, as well as from the Departments of Physics, Chemistry, Chemical and Biomolecular Engineering, Statistics, and Mathematics. Topics of interest include the novel properties and applications of nanostructures, thin films and interface science, microelectromechanical systems (MEMS), short wavelength coherent radiation, X-ray micro-imaging for the life and physical sciences, plasma physics and plasma-assisted materials processing, laser-induced chemical processes, laser probing of complex reacting systems, ultrafast phenomena, particle accelerators, nonlinear dynamics, chaotic systems, numerical methods, and topics in computational fluid mechanics and reacting flows. This program awards the Doctor of Philosophy degree.

In addition, students who are admitted to the program may also apply for the Designated Emphasis (DE) in nanoscale science and engineering (DE NSE), Energy, Science, and Technology (DE EST), and Computational Science and Engineering (DE CSE). Students usually apply for these DE during their first or second year of study. For further information about the DE NSE, see here (<u>http://nano.berkeley.edu/educational/</u> DEGradGroup.html); the DE EST, see here (<u>http://me.berkeley.edu/</u> deest); and the DE CSE, see here. (<u>http://citris-uc.org/decse</u>)

Graduate research in the AS&T Program benefits from state-of-theart experimental facilities at the Berkeley campus and the Lawrence Berkeley National Laboratory. Among these facilities are the National Center for Electron Microscopy, with the world's highest resolution highvoltage microscope; a microfabrication lab for student work involving lithography, MEMS ion-implantation, and thin-film deposition; an integrated sensors laboratory: femtosecond laser laboratories: optical. electrical, and magnetic resonance spectroscopies; short wavelength laser and X-ray research laboratories; an unparalleled variety of material, chemical, and surface science analytic equipment; and a soft X-ray synchrotron dedicated to materials, chemical, and biological research using high-brightness and partially coherent X-rays. The interdisciplinary, collaborative nature of the AS&T Program provides ample opportunity to develop new research directions by making the best use possible of these facilities and of the other research instrumentation available to AS&T faculty.

Graduate Courses

Students in the AS&T Program take courses from regular departments with the concurrence of faculty advisers. In addition, AS&T sponsors the following courses: AST 210/EE 213, Soft X-Rays and EUV Radiation (3

units); AST 239/EE 239, Partially Ionized Plasmas (3 units); AST 225/ MSE 225, Thin-Film Science and Technology (3 units); AST 295R/ChemE 295R, Applied Spectroscopy (3 units); AST 299, Individual Study or Research (1-12 units).

Admission

The complete application, including transcripts, GRE scores, TOEFL scores (if applicable), three letters of reference, and a statement of academic and professional goals, is due in mid-December for the following fall semester. For more information, students should contact the Applied Science and Technology Graduate Group, 210 Hearst Memorial Mining Building #1760, University of California, Berkeley; Berkeley, CA 94720-1760. Phone: (510) 642-0449 e-mail at ast.program@coe.berkeley.edu.

AST C210/EL ENG C213 Soft X-rays and Extreme Ultraviolet Radiation 3 Units

Department: Applied Science and Technology; Electrical Engineering **Course level:** Graduate

Term course may be offered: Spring

Grading: Letter grade.

Hours and format: 3 hours of Lecture per week for 15 weeks. **Prerequisites:** Physics 110, 137, and Mathematics 53, 54 or equivalent. This course will explore modern developments in the physics and applications of soft x-rays. It begins with a review of electromagnetic radiation at short wavelengths including dipole radiation, scattering and refractive index, using a semi-classical atomic model. Subject matter will include the generation of x-rays with laboratory tubes, synchrotron radiation, laser-plasma sources, x-ray lasers, and black body radiation. Concepts of spatial and temporal coherence will be discussed. Formerly known as El Engineering 290G.

AST C225/MAT SCI C225 Thin-Film Science and Technology 3 Units

Department: Applied Science and Technology; Materials Science and Engineering

Course level: Graduate

Term course may be offered: Spring

Grading: Letter grade.

Hours and format: 3 hours of Lecture per week for 15 weeks. **Prerequisites:** Graduate standing in engineering, physics, chemistry, or chemical engineering.

Thin-film nucleation and growth, microstructural evolution and reactions. Comparison of thin-film deposition techniques. Characterization techniques. Processing of thin films by ion implantation and rapid annealing. Processing-microstructure-property-performance relationships in the context of applications in information storage, ICs, microelectromechanical systems and optoelectronics. Instructor: Wu

AST C239/EL ENG C239 Partially Ionized Plasmas 3 Units

Department: Applied Science and Technology; Electrical Engineering **Course level:** Graduate

Term course may be offered: Spring. Offered alternate years. Grading: Letter grade.

Hours and format: Forty-5 hours of lecture per term.

Prerequisites: An upper division course in electromagnetics or fluid dynamics.

Introduction to partially ionized, chemically reactive plasmas, including collisional processes, diffusion, sources, sheaths, boundaries, and diagnostics. DC, RF, and microwave discharges. Applications to plasmaassisted materials processing and to plasma wall interactions. Formerly known as 239.

AST C295R/CHM ENG C295R Applied Spectroscopy 3 Units

Department: Applied Science and Technology; Chemical & Biomolecular Engineering

Course level: Graduate

Term course may be offered: Spring

Grading: Letter grade.

Hours and format: 3 hours of Lecture per week for 15 weeks. **Prerequisites:** Graduate standing in engineering, physics, chemistry, or chemical engineering; courses: quantum mechanics, linear vector space theory.

After a brief review of quantum mechanics and semi-classical theories for the interaction of radiation with matter, this course will survey the various spectroscopies associated with the electromagnetic spectrum, from gamma rays to radio waves. Special emphasis is placed on application to research problems in applied and engineering sciences. Graduate researchers interested in systematic in situ process characterization, analysis, or discovery are best served by this course. Instructor: Reimer