Physics 243A--Surface Physics of Materials: Basic Concepts and Spectroscopy (CRN 83702) Fall Quarter, 2008

Surface and interface physics has had a dramatic growth in importance in recent years due to the increased interest in nanometer-scale structures and materials, which may have a majority of their atoms at the surface or at buried interfaces between two phases. Such surface and interface structures are crucial in a wide variety of technological applications, including very large scale integrated circuits, magnetic storage media, chemical catalysis, corrosion inhibition, tribology (friction and lubrication), environmental science, and biological science. Such surface/interface systems often exhibit markedly different properties from those of the constituent bulk materials, as for example surface composition alterations, surface relaxations or distortions of atomic positions relative to the underlying lattice, and unusual surface electronic or magnetic properties. Buried surfaces or interfaces are ubiquitous in technology and are similarly varied in properties.

A number of experimental techniques, theoretical models, and computational methods have thus been developed in order to better understand and control such surface and interface properties. Synchrotron radiation has also become an indespensible tool for such systems, with about 40 such facilities worldwide.

Physics 243A will introduce these subjects as the first of a two-to-three-quarter sequence that will be offered in 2008-2009. 243A will first consider some basic properties of surfaces, including their electronic structure and the theoretical approaches that are used to model them, and then turn to the principal spectroscopic probes of surfaces and interfaces. Special emphasis will be on photoelectron spectroscopy, diffraction, and holography using both laboratory excitation sources and synchrotron radiation, and the various other spectroscopies provided by synchrotron radiation (e.g., x-ray absorption and x-ray emission spectroscopies), and the closely related Auger spectroscopy. This course is designed to be complementary in subject matter to the subsequent quarters of Physics 243: 243B will be offered in Winter by Prof. Chiang and will stress surface atomic structure and microscopy, and depending on student interest level, 243C will be offered in Spring and will stress the theoretical background of surface electronic structure calculations and experimental techniques.

Instructor:

Chuck Fadley, Physics/Geology 241, Telephone: 530-752-8788, E-mail: fadley@physics.ucdavis.edu.

Prerequisites:

- **Introduction to quantum mechanics (Physics 215A,B) and/or quantum chemistry (Chemistry 210A,B)**
- **Introduction to solid state physics (Physics 140A and/or Physics 240A recommended, but not required)**

Textbooks:

Required:

- ***"Modern Techniques of Surface Science",* D.P. Woodruff and T.A. Delchar, 2nd Edition (Cambridge University Press, 1994)--an up-to-date text on experimental methods in surface science**
- ***"Physics at Surfaces*", A. Zangwill (Cambridge University Press, 1988)--a thorough treatment of the various aspects of surface physics, including concise theoretical discussions of many topics**
- **Copies of current review articles on photoelectron spectroscopy and diffraction, synchrotron radiation, and other topics, to be handed out in class**

Recommended for theoretical background:

- ***"Concepts in Surface Physics"*, M.C. Desjonqueres and D. Spanjaard, 2nd Edition (Springer Verlag, 1996, corrected printing 1998)--a newer text, with much more detail concerning the theoretical methods of surface physics, and a useful general reference, e.g. to augment Zangwill.**

Time and place: **Tuesdays, Thursdays, 12:10-1:30 PM, Phys/Geo 432, plus supplementary lectures to be arranged to compensate for instructor absence during the quarter.**

--Course assessment: Grading in the course will be based on the following:

Graded problem sets	**40%**
Midterm exam	**20%**
Comprehensive final	**40%**
	100%

--Final examination: **Tuesday, December 9th , 10:30-12:30, Phys/Geo 432 or, if desirable, another timeslot by unanimous agreement.**