Electron Spectroscopy

Description:

The Electron Spectroscopy Program has undergone a major shift in emphasis in recent years. The development of a range of new instrumentation is allowing a concerted effort in the general area of correlated systems, including the cuprates, the basis of the high T, superconductors, the related nickelates, and the manganates, the basis of the colossal magneto-resistance materials. Aside from the obvious technological potential, these materials offer a whole range of new challenges in fundamental physics. Work also continues on a more limited basis in the general area of the electronic and magnetic structure of surfaces and thin films.

New experimental capabilities include a high resolution photoemission system having the ability to measure photoemission spectra for a large range of angles simultaneously. Both the energy and momentum resolution are considerably enhanced with respect to conventional systems. A new spin polarimeter has been coupled to this instrument allowing spin polarized photoemission spectra to be measured with an energy resolution considerably higher than that previously obtained in such studies. Funded by a recently awarded New Initiative, new capabilities are also being developed in infra-red spectroscopy. Here the intent is to couple commercially available Bruker spectrometers to beam lines at the National Synchrotron Light Source. This will allow studies of the low frequency dynamics of the so-called "bad metals". By measuring the response of the system over a wide frequency range, it will be possible to examine, in detail, the complex conductivity of these materials.

Impact

Seminal studies of the spin polarization of quantum well states formed on noble metal thin films deposited on ferromagnetic substrates, focused the discussion of the proposed mechanism for oscillatory exchange coupling in the associated magnetic multilayers on the relative binding energies of the spin dependent band gaps.

Pioneering work on the electronic properties of ultra thin films including studies of the effects of disorder on superconductivity and the related transition from the superconducting to insulating state. In addition, detailed studies were made of the changes in electronic structure of metallic monolayers deposited on metallic substrates and how these changes are related to chemical reactivity and the uptake of hydrogen. In particular, the latter studies have resulted in a considerable research effort devoted to the study of modifications of catalytic activity by metallic monolayers.

Interactions:

Current Collaborations: Boston University, University of Connecticut, LaJolla UCSD, Penn State, NIST and Temple University.

Personnel:

Peter D. Johnson (Group Leader), Chris Homes, Myron Strongin, Alexei V. Fedorov, Tonica Valla (Research Associate), Patrick Henning (Research Associate-UCSD).

Recognition:

In the past two years, 12 invited talks and Department Colloquia and two Fellows of the APS.

Budget : $1300 K.