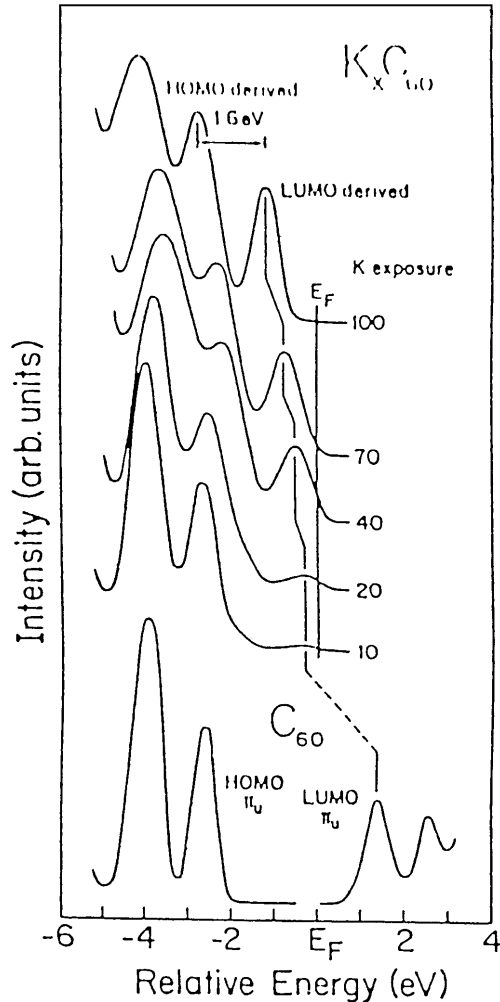


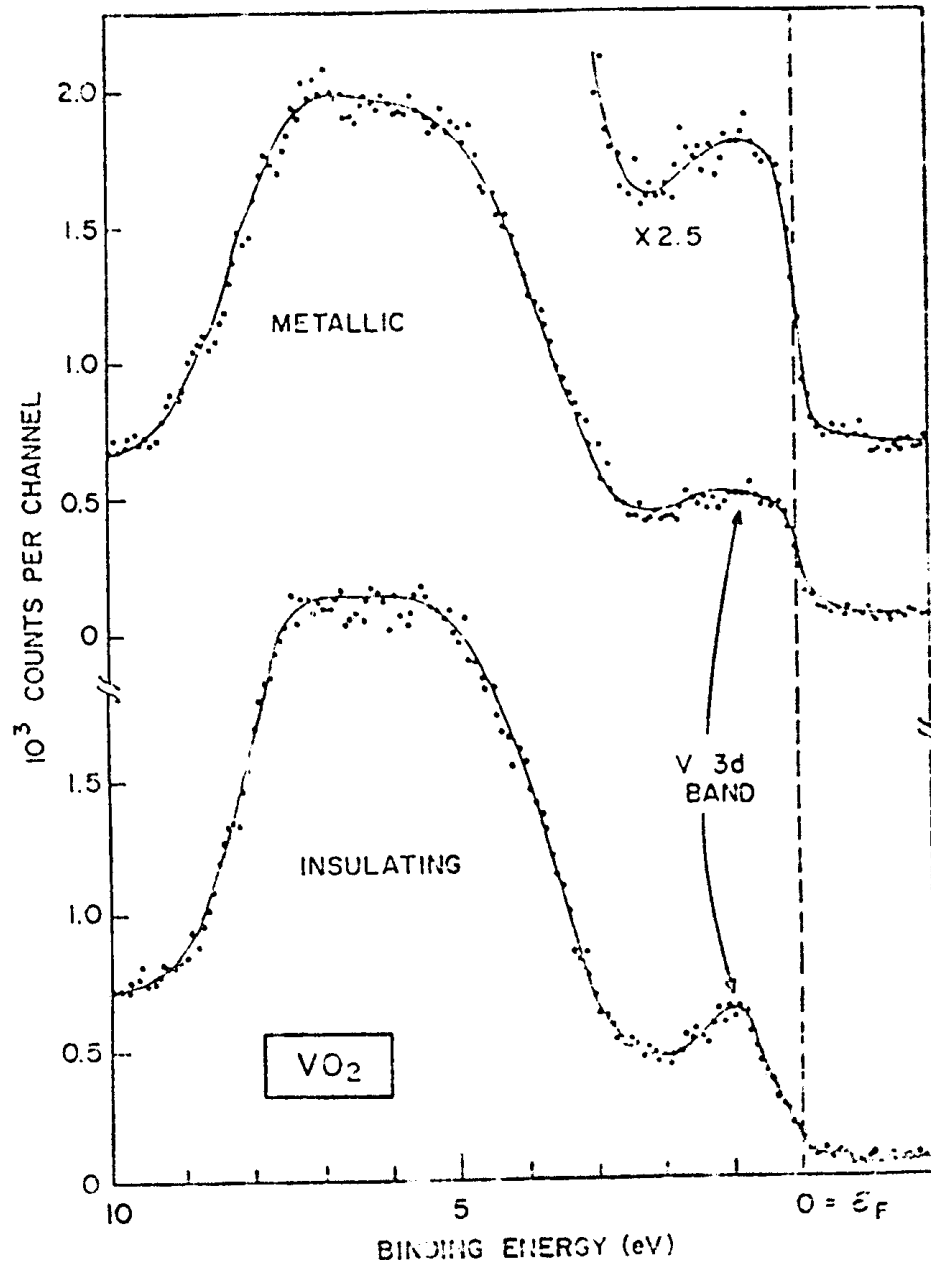
Lecture 13

Some applications of XPS



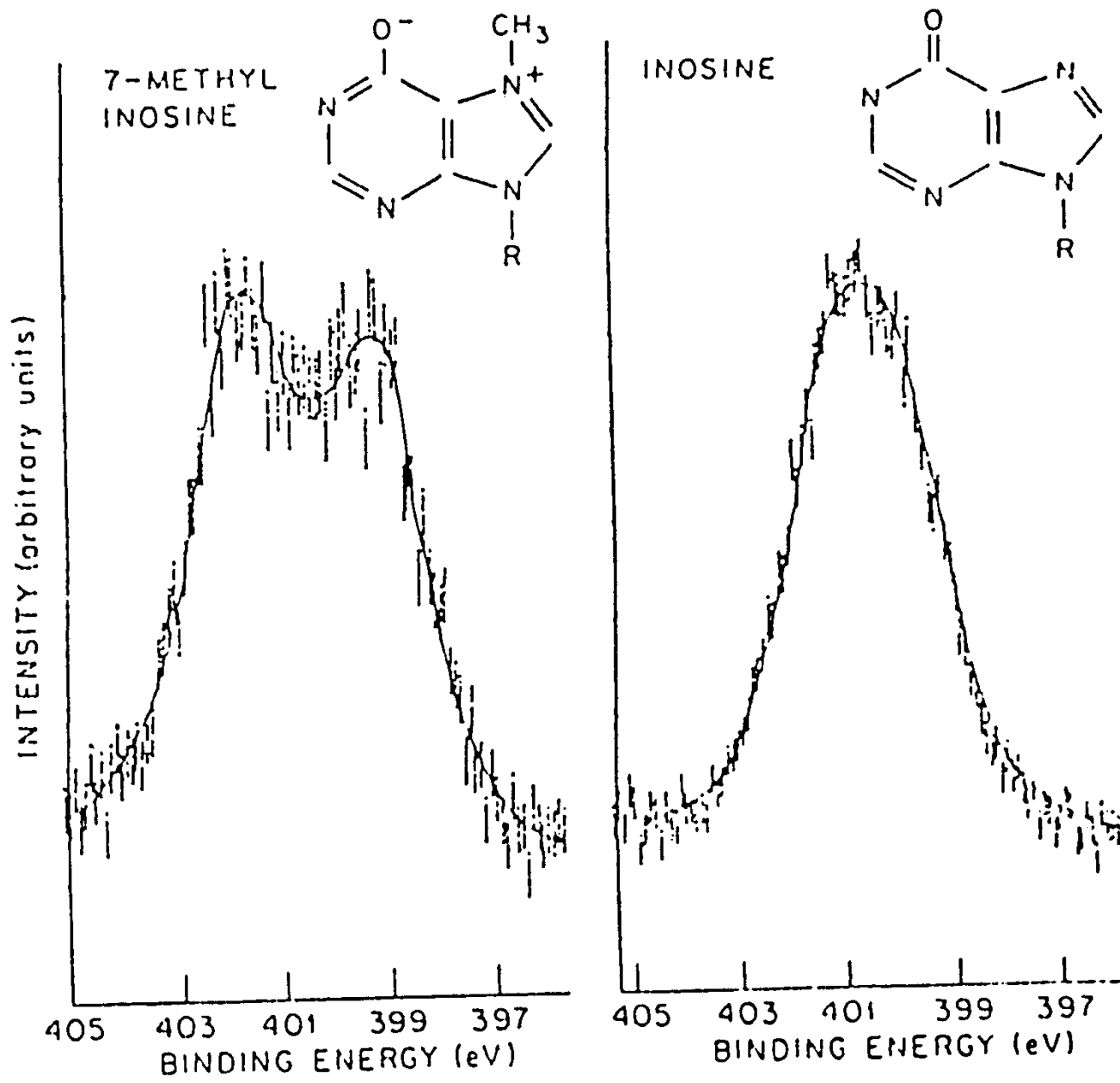
Photoemission spectra for solid C_{60} as a function of K exposure (in timed increments) normalized to the intensity of the largest feature. The bottom curve shows the occupied states of the pure fullerene, together with results for the empty states from inverse photoemission (10). All spectra are aligned to the Fermi level. The energies for the molecular solids reflect the removal or addition of an electron when the Fermi level does not lie within a band. K incorporation results in the non-rigid band occupancy of the LUMO-derived states. The metallic state is characterized by the location of E_F within this LUMO-derived band. Continued K incorporation fills the LUMO-derived band, producing the insulating state characterized by the top spectrum.

The spectrum demonstrates the origin of metallicity upon doping. Look at the emergence of intensity at Fermi and the gradual disappearance with further doping. See the shift of LUMO.



This change in population is further demonstrated here.

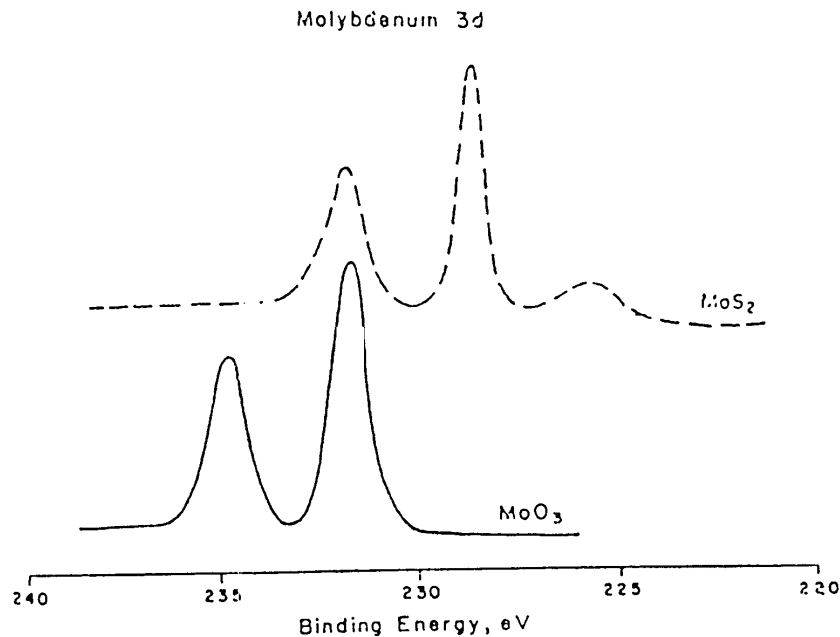
Fig. 9. Valence and conduction bands of insulating and metallic VO_2 (from Wertheim.²⁷)



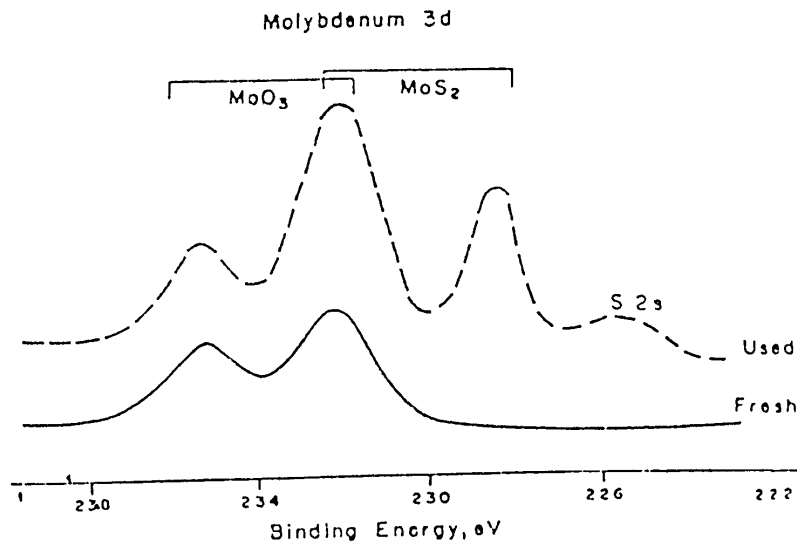
Two distinct states can be demonstrated. It is important to know that the charge is not fully on one nitrogen.

Comparison of N(1s) photoelectron spectra for inosine and 7-methyl inosine. [L. D. Hulett and T. A. Carlson, unpublished data.]

One typical application where surface composition is assessed.

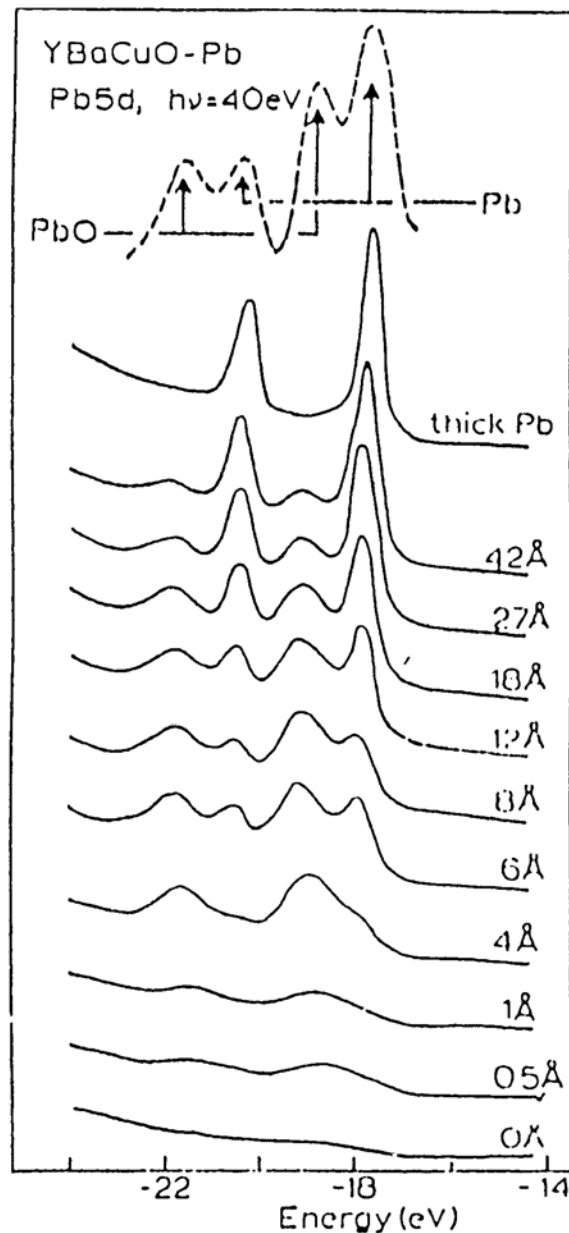


ESCA spectra of MoO₃ versus MoS₂; the peak at ca 226 eV in the MoS₂ spectrum is due to the sulfur 2s line.



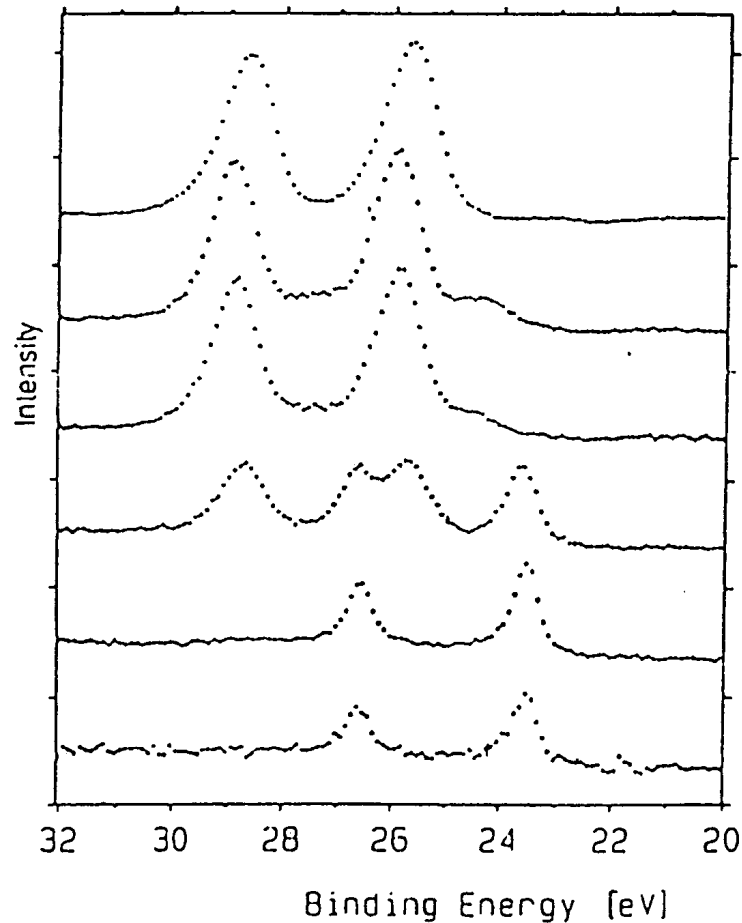
The molybdenum 3d spectra of a fresh and used desulfurization catalyst; the spectrum of the used catalyst exhibits both oxide and sulfide species

An example of a research study, utilising the surface sensitivity and characteristic chemical signature capabilities of XPS.

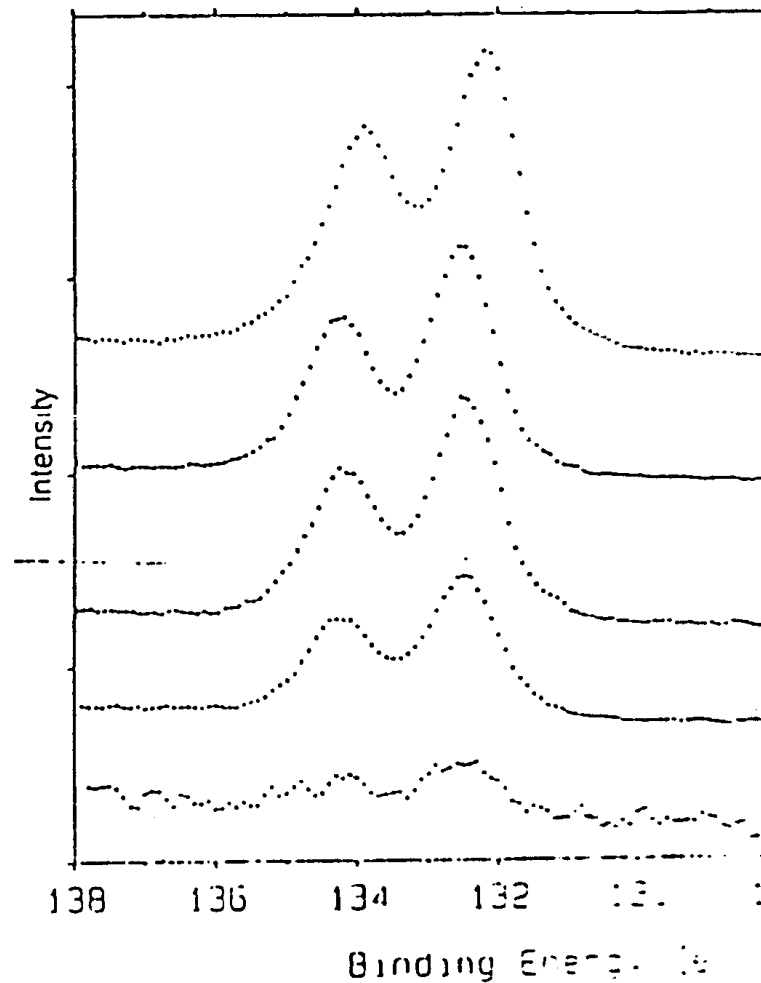


Photoemission spectra²⁴ of the Pb 5d core level, taken on PbO (top, dashed line) and on a freshly cleaned YBaCuO surface progressively covered by Pb overlayers of increasing thickness. The nominal thickness is shown for each spectrum.

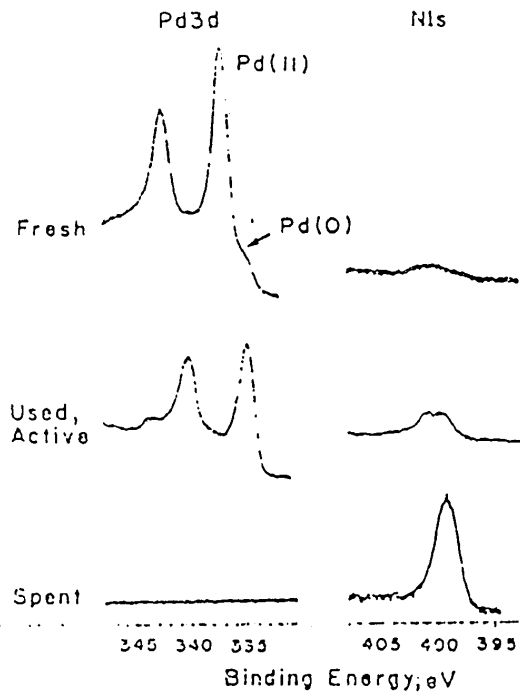
Similar study



Photoelectron spectra of the Bi5d region. From top: Clean $\text{Bi}_2\text{CaSr}_2\text{Cu}_2\text{O}_8$, 1 Å Cu overlayer deposited and measured on a cold crystal (approx 100 K), 1 Å Cu on RT crystal, 6 Å Cu RT, 24 Å Cu RT and at bottom 24 Å Cu RT but with 60° angle of electron emission (surface sensitive). The intensity of the top spectrum, the clean crystal, has been reduced with a factor of 2 while the bottom spectra, 6 Å to 24 Å Cu, are multiplied by 2

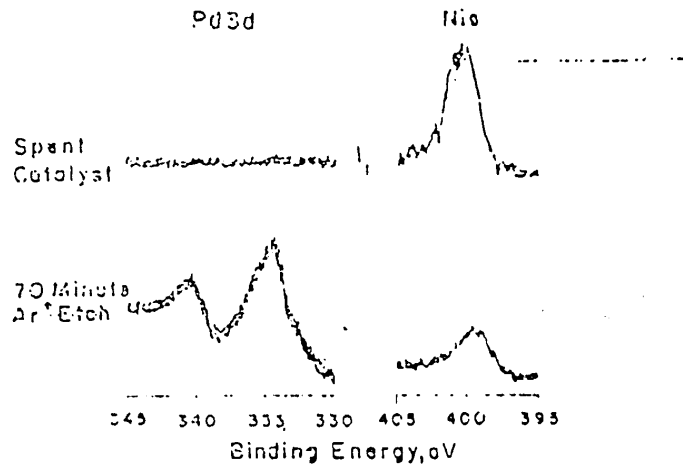


Photoelectron normal emission spectra of the S region. From top: Clean $\text{Bi}_2\text{CaSr}_2\text{Cu}_2\text{O}_8$ (1 Å Cu overlayer on cold crystal, 1 Å Cu on RT crystal, Cu RT, and at bottom 24 Å Cu RT spectrum. The intensity of the 6 Å Cu spectrum, second from bottom, has been multiplied by 2 while the 12 Å Cu, bottom spectrum, has been multiplied by 2.



A catalysis application

ESCA spectra of a fresh, used, and spent charcoal-supported palladium catalyst.



ESCA spectra of a spent charcoal-supported palladium catalyst before and after Ar⁺ ion etching.