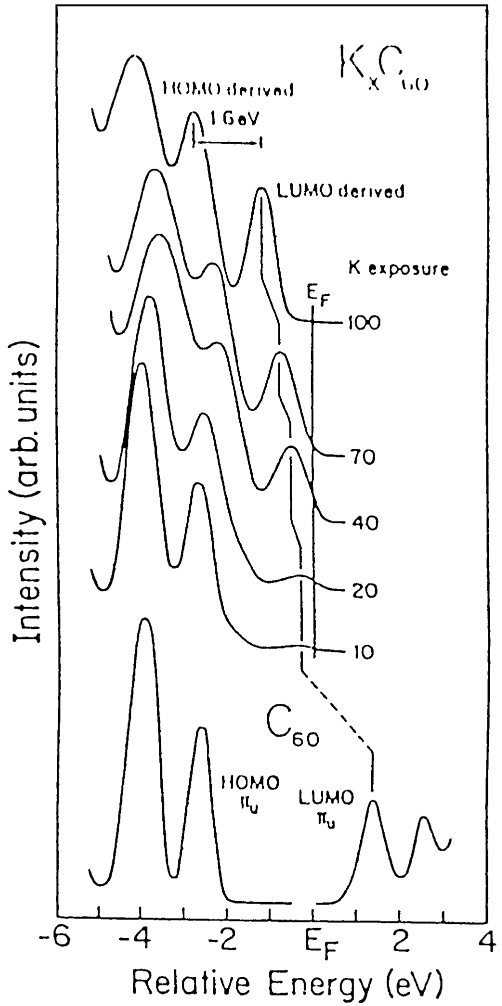
Lecture 13
Some applications of XPS



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.

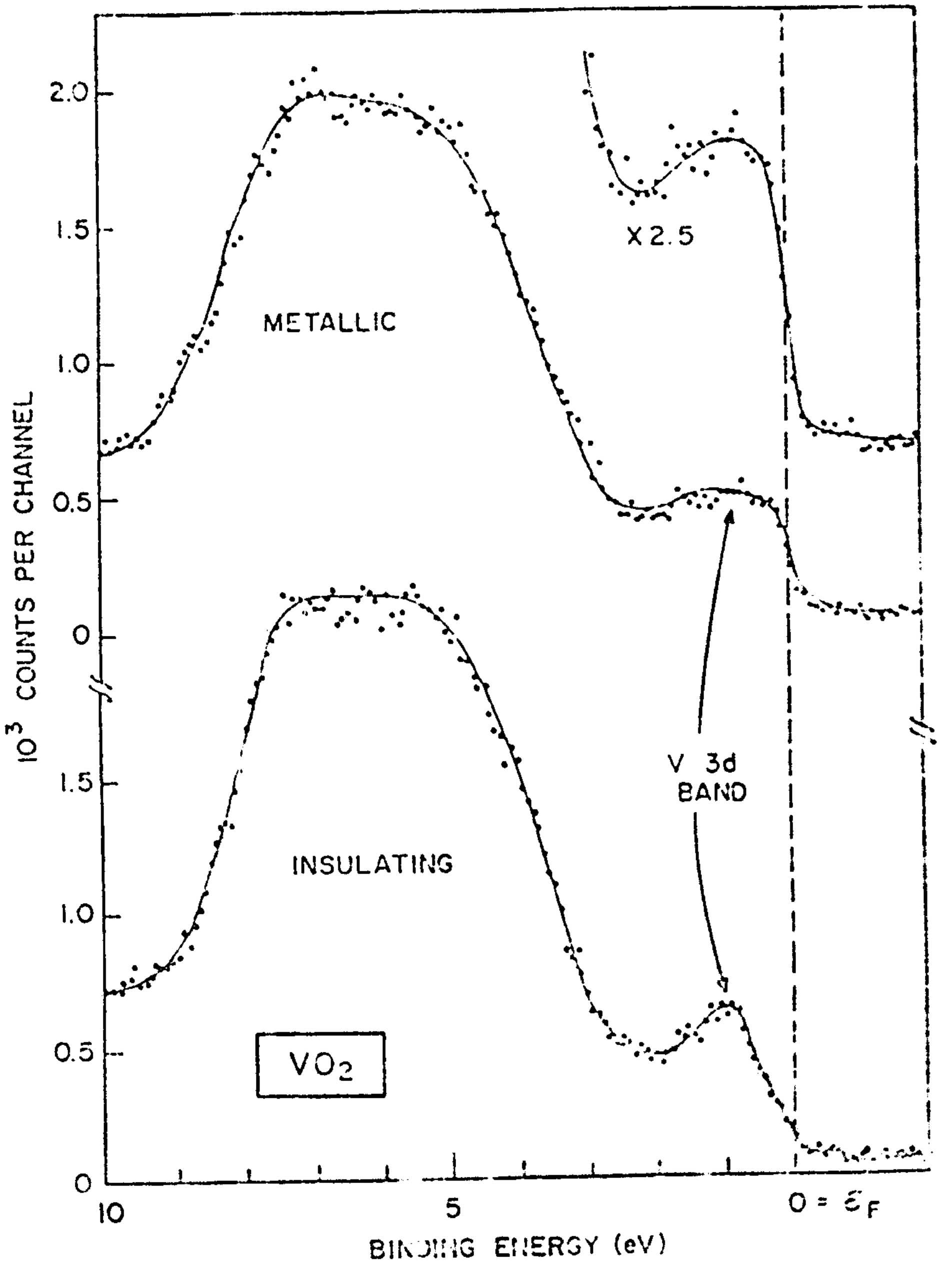
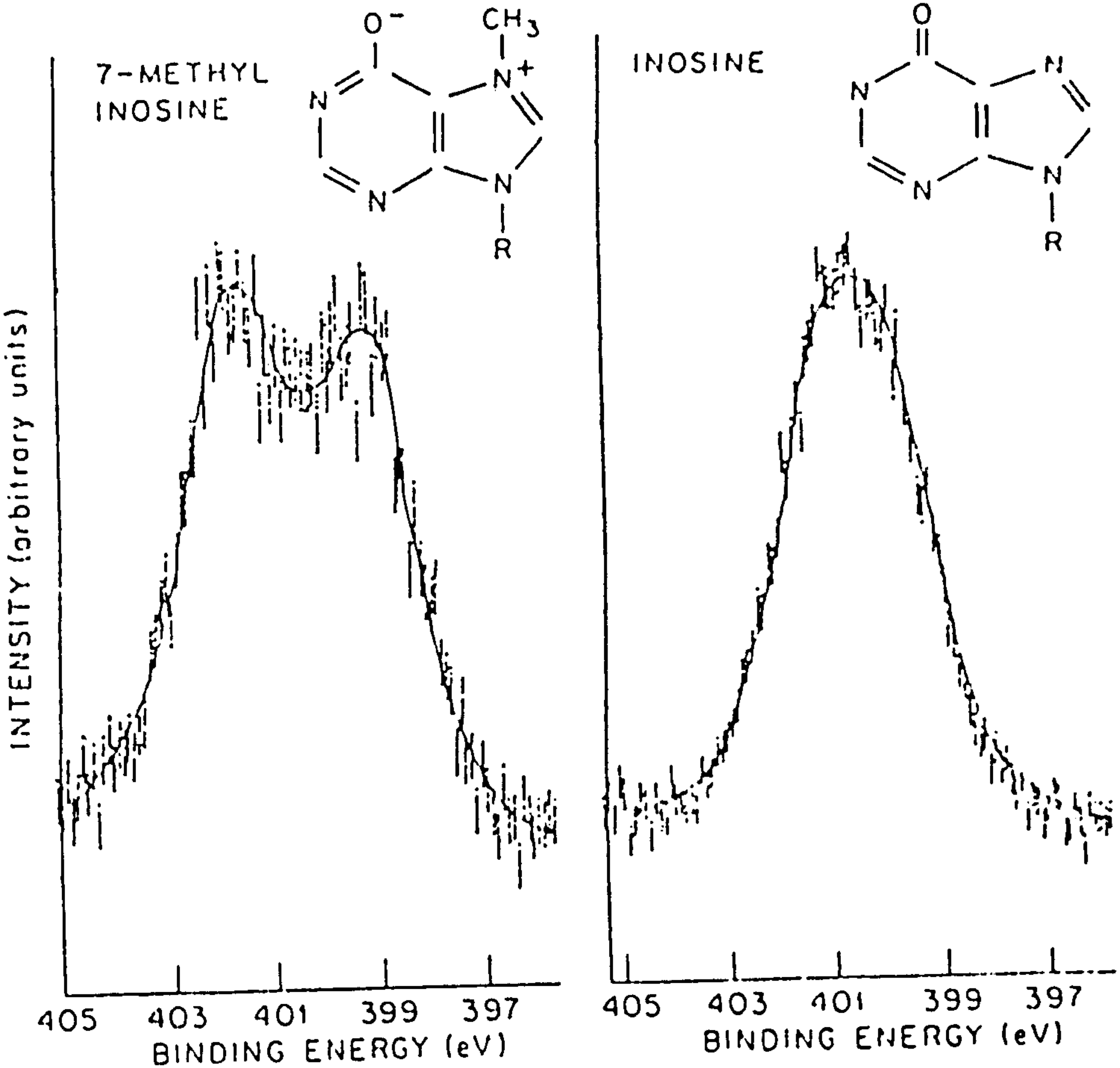


Fig. 9. Valence and conduction bands of insulating and metallic VO_2 (from Wertheim.[87])

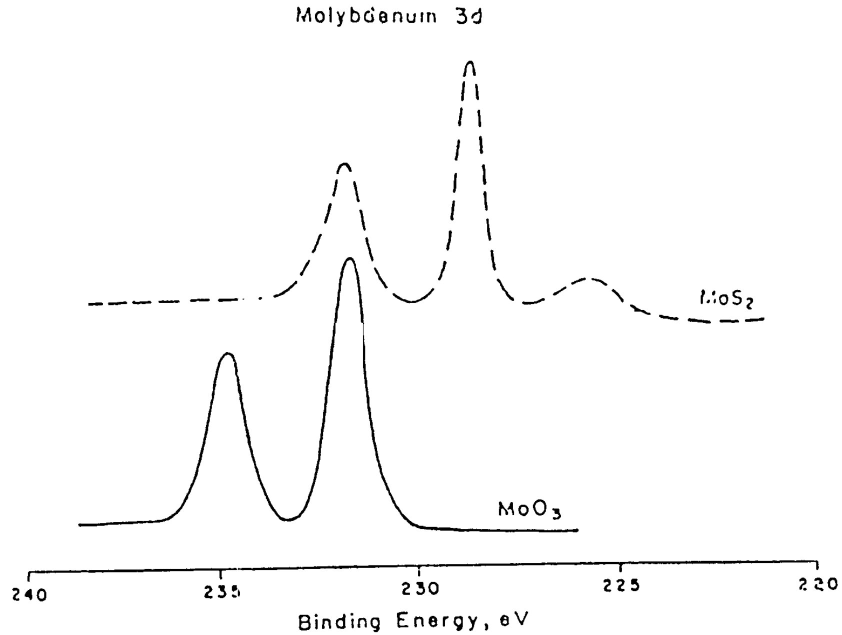
This change in population is further demonstrated here.



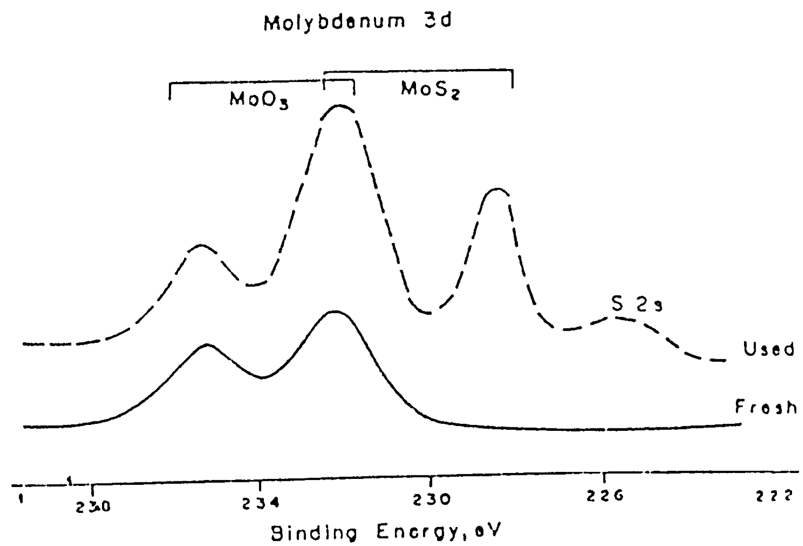
Comparison of N(1s) photoelectron spectra for inosine and 7-methyl inosine. [L. D. Hulett and T. A. Carlson, unpublished data.

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

One typical application where surface composition is assessed.

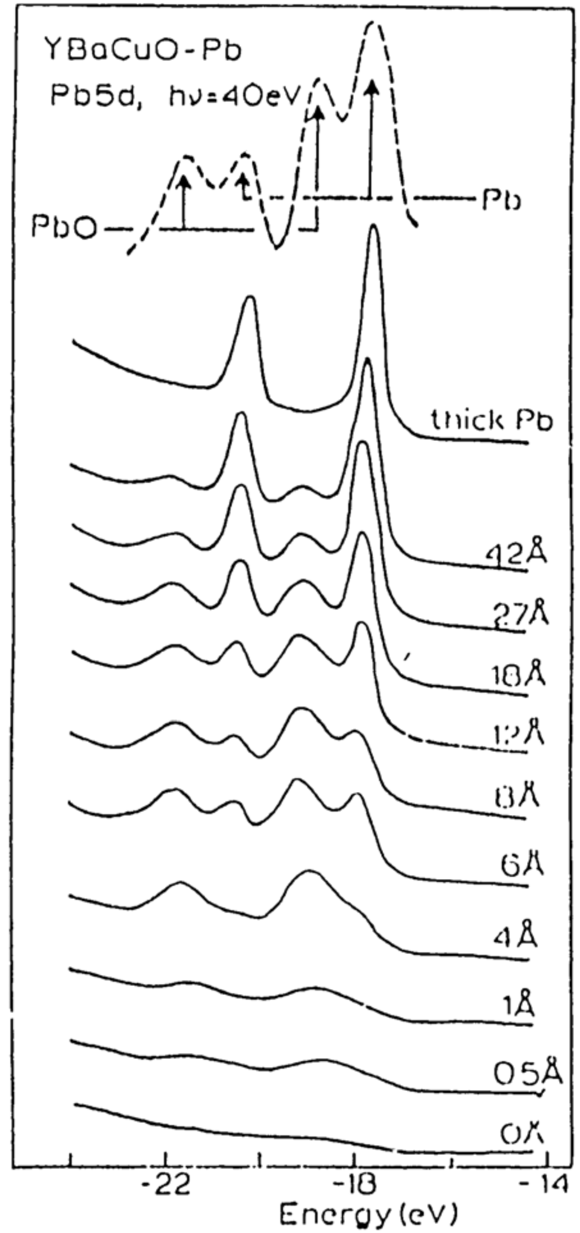


ESCA spectra of MoO_3 versus MoS_2; the peak at ca 226 eV in the MoS_2 spectrum is due to the sulfur 2*s* line.



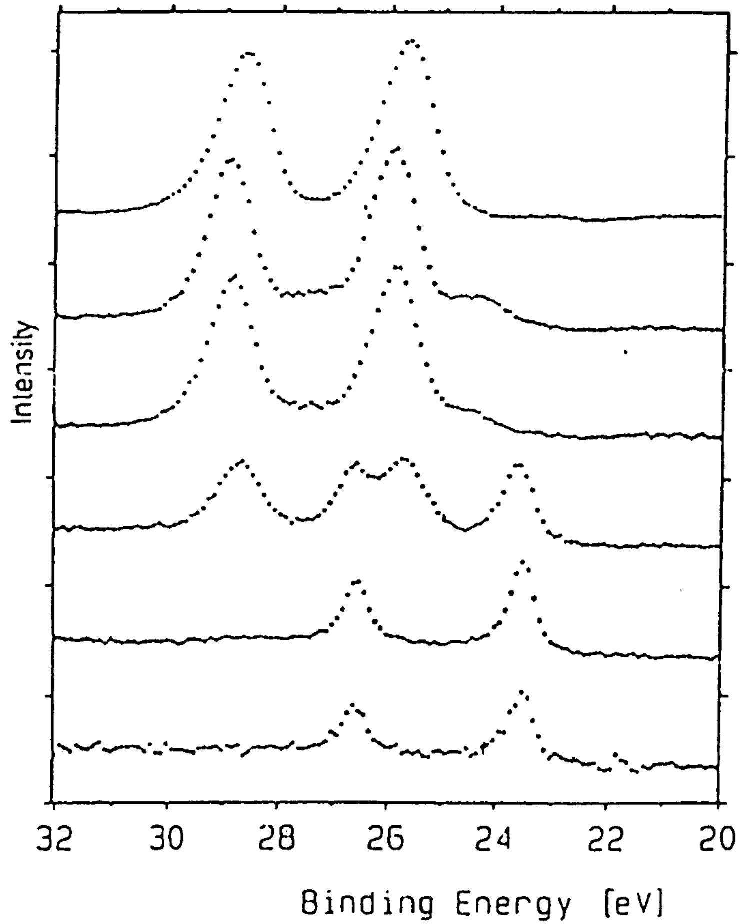
The molybdenum 3*d* spectra of a fresh and used desulfurization catalyst; the spectrum of the used catalyst exhibits both oxide and sulfide species

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

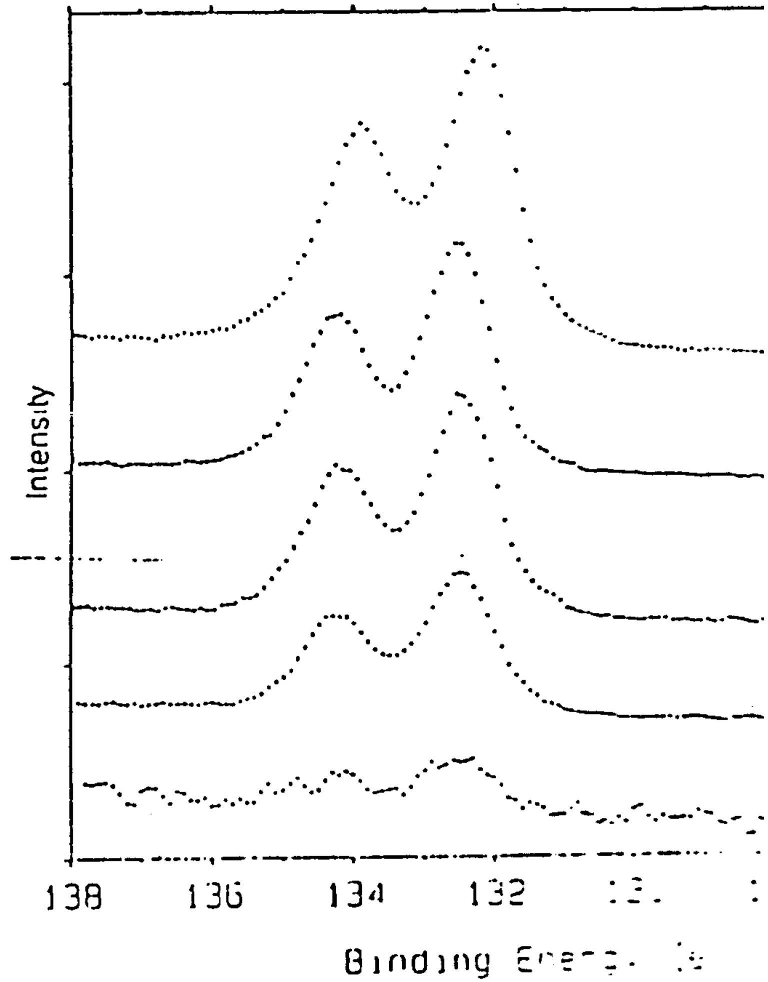


Photoemission spectra[24] of the Pb 5*d* core level, taken on PbO (top, dashed line) and on a freshly cleaned YBaCuO surface progressively covered by Pb overlayers of increasing thickness. The nominal thickness is shown for each spectrum.

Similar study

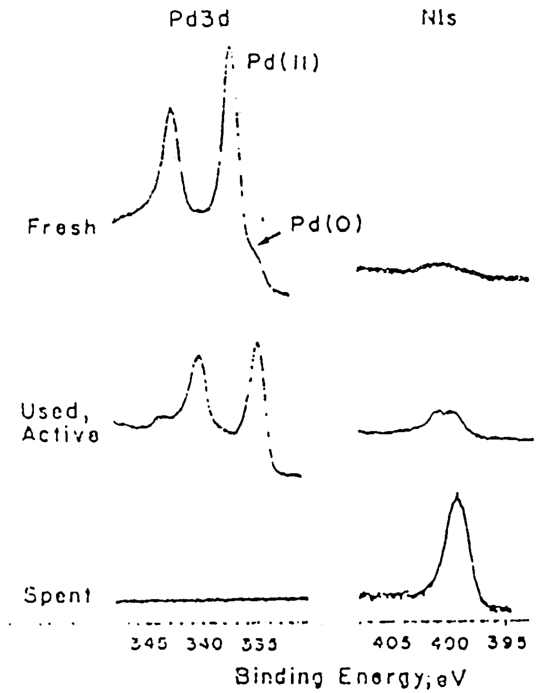


Photoelectron spectra of the Bi5d region. From top: Clean $Bi_2CaSr_2Cu_2O_8$. 1 Å Cu overlayer deposited and measured on a cold crystal (approx 100 K), 1 Å Cu on RT crystal, 6 Å Cu RT, 24 Å Cu RT and at bottom 24 Å Cu RT but with 60° angle of electron emission (surface sensitive). The intensity of the 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

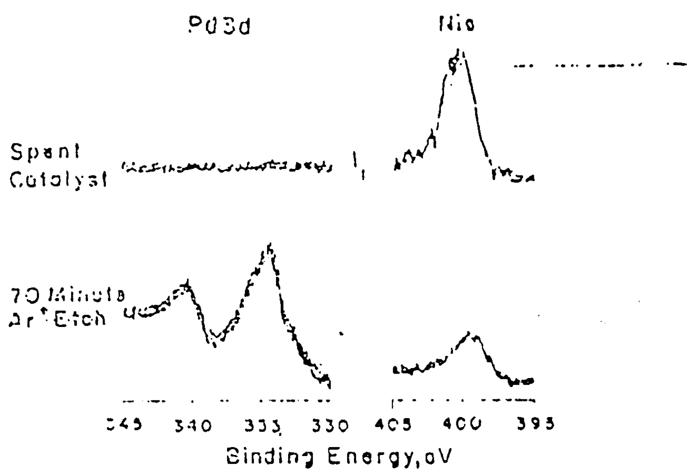


Photoelectron normal emission spectra of the S
region. From top: Clean Bi_2CaSr_2C... 1 Å
overlayer on cold crystal, 1 Å Cu on RT crystal
Cu RT, and at bottom 24 Å Cu RT spectrum
intensity of the 6 Å Cu spectrum, second from
bottom, has been multiplied by 2 while the
Cu, bottom spectrum, has been multiplied

A catalysis application



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



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