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HIGH RESOLUTION AUGER ELECTRON SPECTROSCOPY OF NITRIC OXIDE ADSORBED ON A TUNGSTEN SURFACE

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High resolution Auger spectra indicate that NO is dissociatively adsorbed on a polycrystalline tungsten surface at room temperature.

We have reported previously on the effectiveness of high resolution AES in identifying the states of gases chemisorbed on metal surfaces.[1] In continuation of work, this experimental technique has been applied to study the behavior of NO adsorbed on a polycrystalline tungsten surface at room temperature, a system of current interest in air pollution. The adsorption of NO on a W surface was studied by Yates and Madey at room temperature by means of flash desorption technique,[2] which indicates that the adsorption was largely non-dissociative. The study of X-ray photoelectron spectroscopy,[3] however, leads a conclusion that the adsorption of NO is either non-dissociative or dissociative.

The general experimental technique has been described previously.[4] A vacuum chamber was evacuated down to a pressure of 5×10^{-9} Torr by 500 litre/sec ion pump together with a Ti getter pump with liq. N_2. A clean W surface was obtained by flashing an oxidized sample in vacuo. Primary energy of an electron beam with its current of 1×10^{-6} A was 1.3 keV. To minimize possible dissociation of the adsorbed species by the electron beam, the beam was defocused. By assuming a collision cross-section of 10^{-19} cm^2, a probability of interaction between the adsorbates and the electron beam during the measurements was estimated to be from 10^{-1} to 10^{-3}. The non-derivative Auger spectra were obtained with a multiple scanning technique.[4]

As shown in Figure, the shapes of the KLL Auger peaks of N and O atoms on the W surface are quite different from those of gaseous NO,[5] but are essentially identical to those of the nitride[1] and the oxide,[6] respectively, which is interpreted to show that NO is dissociatively adsorbed on the W surface and that the surface nitrogen and oxygen are directly held by the W surface. The spectra in the figure(a) can be assigned on the basis of an intermediate coupling scheme ("atomic model").[7] In addition, the spectra in this figure(a) are markedly different in their shapes from those of NO(a molecular type) adsorbed on a Pd surface.[8] In the cases of both W and Pd, the shapes and the intensity ratio of N and O were not changed with time during the measurements, which indicates no effects of the electron beam in this experimental condition.

The high resolution AES can be effective as a fingerprint technique to study the most abundant states of chemisorbed species on catalyst surfaces as well as a tool for conventional elemental analyses.

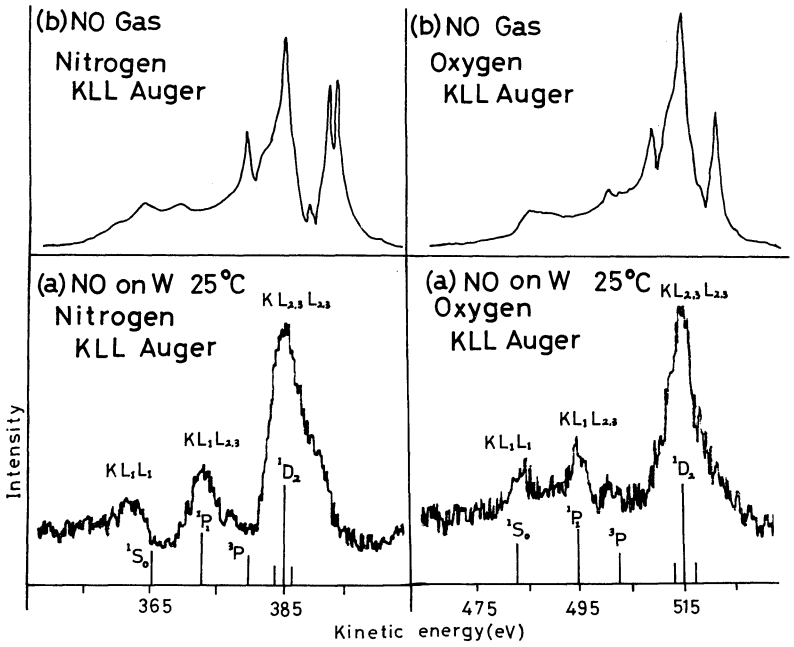

FIGURE. (a) High resolution Auger spectra of NO adsorbed on W at room temperature. (P_{NO} = 4 x 10^{-7} Torr) The vertical solid lines represent energies calculated by the intermediate coupling scheme.[7] The calculated values are shifted to match the observed main peak with the calculated peak($^1D_2$).
(b) Auger spectra of gaseous NO[5] as a reference.

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