

Photon-Induced Reaction Study of SF₆ Adsorbed on Si(111)-7x7 Using Monochromatic Synchrotron Radiation

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We present an analysis of the photon-exposure dependence of the F(1s) core-level photoemission spectrum from SF₆ adsorbed on Si(111)-7x7 irradiated by monochromatic synchrotron radiation with photon energy near the F(1s) core-level. The photoemission data was collected using synchrotron radiation at NSRRC Wide-Range beam line. In the present work, a surface was studied for the soft x-ray-induced photochemical reactions using core-level photoemission spectroscopy. The surface was prepared by exposure of a clean Si(111)-7x7 surface to 1.35×10^{14} molecules/cm² of SF₆ at 30 K. A series of photoemission spectra was taken in time during continual irradiation of monochromatic photons until little visual difference was observed in the two most recent spectra. This series of photoemission spectra (Fig. 1 and Fig. 2) indicates that there is a dramatic change in the spectra as a result of exposure to the photon beam.

peak position also changes. These changes are not a result of contamination, as subsequent PES of an area of the sample that had not been previously exposed to the photon beam resulted in a spectrum that was identical to the top spectrum in Fig. 1. The decrease of the peak intensity of F(1s) indicates that the number of fluorines in the SF₆ layer decreases with increasing photon exposure. The change of the binding energy of F(1s) with photon exposure depicts that the binding energy of F(1s) decreases with increasing photon exposure because of changing chemical species. A kinetic model was proposed for the explanation of the photolysis of the SF₆-dosed surface induced by the incident photons, and the energy shift of the F(1s) binding energy.

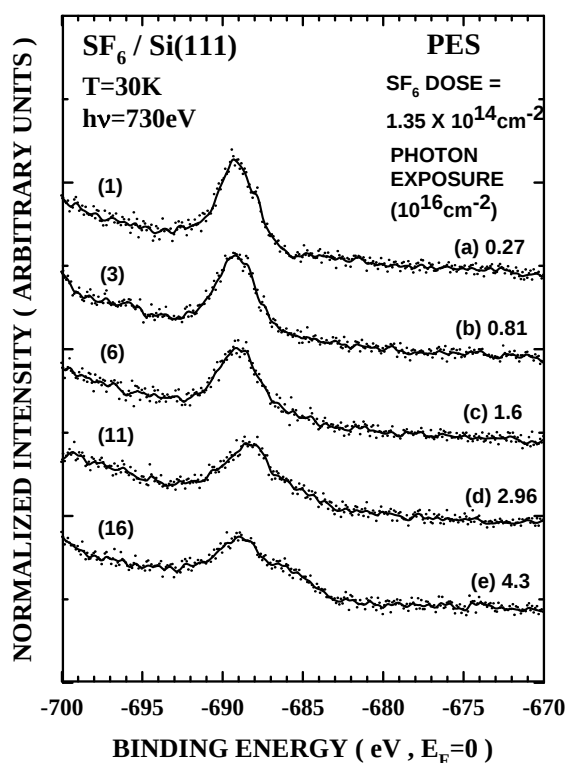


Figure 1. Series of core-level photoemission spectra of SF₆ adsorbed on Si(111)-7x7 surface at 30 K as a function of photon exposure using 730 eV photons. The SF₆ dose of the surface is 1.35×10^{14} molecules/cm². The total photon exposure for each spectrum is given in units of 10^{16} photons/cm² and shown on the right of the figure.

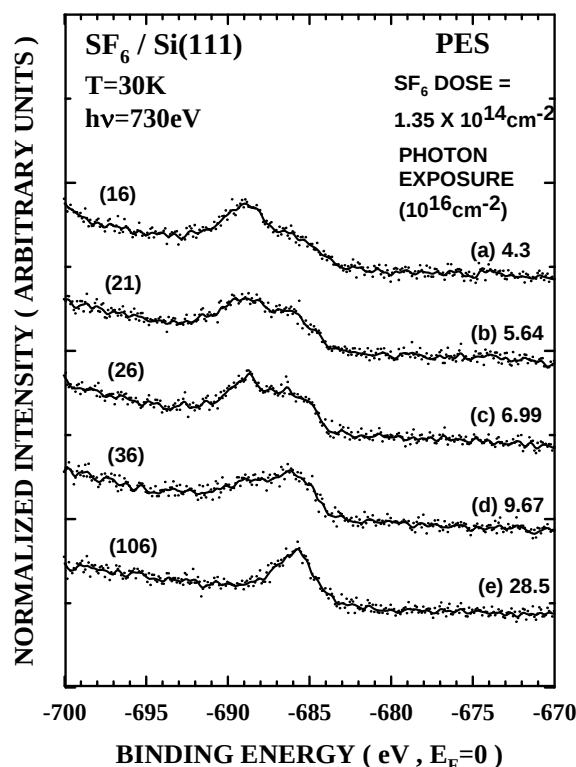


Figure 2. Series of core-level photoemission spectra of SF₆ adsorbed on Si(111)-7x7 surface at 30 K as a function of photon exposure using 730 eV photons. The SF₆ dose of the surface is 1.35×10^{14} molecules/cm². The total photon exposure for each spectrum is given in units of 10^{16} photons/cm² and shown on the right of the figure.

The intensity of the F(1s) peak decreases and the