

Photolysis Studies Using Synchrotron Radiation: $\text{CFCl}_3/\text{Si}(111) 7\times 7$

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The photolysis of CFCl_3 adsorbed on $\text{Si}(111)-7\times 7$ surface at 30 K by 98-eV synchrotron radiation was studied by using photoelectron spectroscopy (PES). The photoemission data was collected using synchrotron radiation at NSRRC LSGM beam line. In the present work, the surface was studied for the soft x-ray-induced photochemical reactions using valence-level photoemission spectroscopy. The surface was prepared by exposure of a clean $\text{Si}(111)-7\times 7$ surface to 1.3×10^{14} molecules/ cm^2 of CFCl_3 at 30 K. A series of photoemission spectra was taken in time during continual irradiation of monochromatic photons (98 eV) until little visual difference was observed in the two most recent spectra. These series of photoemission spectra (Fig. 1 and Fig. 2) indicate that there is a dramatic change in the

spectra as a result of exposure to the photon beam. The intensities of all peaks decrease and their relative intensities also change. 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 changes observed in Fig. 1 and 2 are the result of photolysis of the CFCl_3 surface complex due to exposure to the 98 eV photons from the synchrotron radiation source, which indicates a high cross section. A kinetic model was proposed for the explanation of the photolysis of the CFCl_3 -dosed surface induced by the incident photons, and the variation of the spectrum shape of these two spectra.

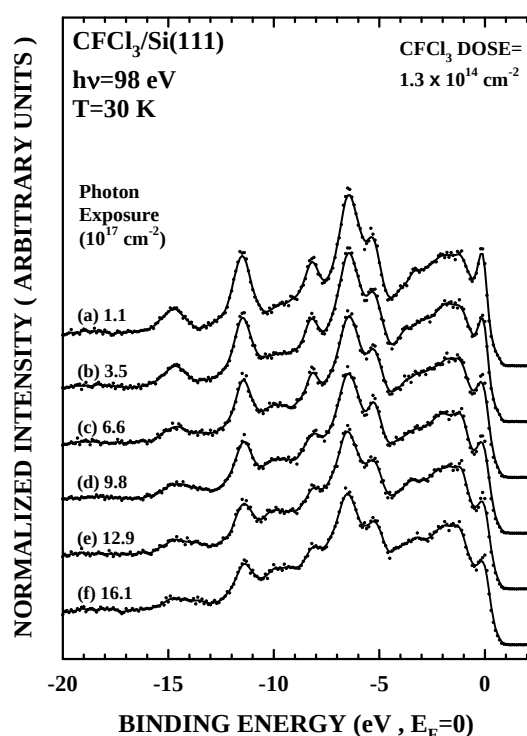


Figure 1. Series of valence-level photoelectron spectra of CFCl_3 adsorbed on $\text{Si}(111)-7\times 7$ at 30 K as a function of photon exposure using 98 eV photons. The CFCl_3 dose of the surface is 1.3×10^{14} molecules/ cm^2 . The total photon exposure for each spectrum is given in units of 10^{17} photons/ cm^2 and shown on the left of the figure.

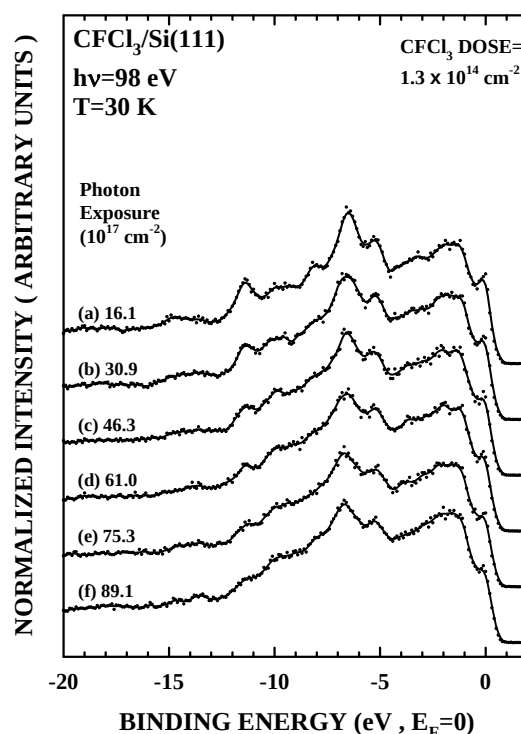


Figure 2. Series of valence-level photoelectron spectra (which extends the series of Fig. 1) of CFCl_3 adsorbed on $\text{Si}(111)-7\times 7$ at 30 K as a function of photon exposure using 98 eV photons. The CFCl_3 dose of the surface is 1.3×10^{14} molecules/ cm^2 . The total photon exposure for each spectrum is given in units of 10^{17} photons/ cm^2 and shown on the left of the figure.