

Photon-stimulated ion desorption from condensed chloroform on Si(100) at the Cl and Si K-edges

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Introdução

Element- and site-selectivity in core-excited adsorbed and condensed systems is a topic of considerable importance either for basic research as well as for technological applications, since it is directly connect to fields like semiconductor processing, catalysis, biochemistry, photon assisted chemical vapor deposition, etc. Several examples are now known in which, following the excitation or ionization of an inner-shell electron and the corresponding relaxation through the Auger process, selective fragmentation is observed around the atom to which the inner-shell electron is closely associated [1]. Ionic desorption is therefore well explained by the Auger process due to the formation of positive holes in valence orbitals, which leads to fragmentation through Coulomb repulsion, the so-called Coulomb explosion mechanism. In addition to the Auger Stimulated Ion Desorption (ASID) mechanism, an indirect process (XESD - X-ray induced electron stimulated desorption) seems to contribute efficiently to the signal in ionic desorption from condensed systems. In this work we present photon stimulated ion desorption (PSID) spectra for condensed chloroform, irradiated around the chlorine 1s-edge at LNLS. Measurements at the silicon 1s-edge were also performed in order to verify the influence of the substrate in the ionic desorption of condensed chloroform.

Resultados e Discussão

PSID spectra recorded at the Si 1s-edge and at different coverage show mainly two ionic features, which were assigned to the H⁺ and Cl⁺ ions using the SIMION program. By increasing the coverage the signal associated to these peaks disappear completely, suggesting that the desorption from H⁺ and Cl⁺ ions at the silicon 1s-edge may be due to secondary electrons formed by inelastically scattered photoelectrons and Auger electrons.

NEXAFS spectrum of condensed chloroform (500L) measured at the chlorine 1s-edge shows three features, which corresponds to transitions from the 1s electron from chlorine to unoccupied orbitals. These

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energies were used to measured PSID spectra from condensed chloroform. Using the program SIMION the more prominent peaks were attributed to H⁺ and Cl⁺ ions. The weaker and broader features around the chlorine peak may correspond to larger fragments. Desorption ion yields for H⁺ and Cl⁺ were determined. Different behaviour can be observed in the energy dependent study. Although the desorption curve for H⁺ shows almost no photon energy dependency, the desorption curve for Cl⁺ has a maximum exactly at the first Cl 1s resonance. This enhancement is an indication that the resonant process at 2823 eV to an antibonding orbital, probably containing C-Cl character, may play an important role in the Cl⁺ desorption [2].

Conclusões

Photon stimulated ion desorption (PSID) studies have been performed in CHCl₃/Si(100) using synchrotron radiation from LNLS at the chlorine and silicon 1s-edges. The results showed that an effective enhancement of the Cl⁺ ion yield takes place via excitation of the chlorine 1s electron to a particular antibonding molecular orbital, suggesting that the Spectator Auger process plays a major role for chlorine desorption. On the other hand, the production of H⁺ is induced mainly by the XESD mechanism. Since for thicker CHCl₃ multilayer the H⁺ and Cl⁺ signals disappear completely at the silicon 1s-edge, it is possible to attribute the formation of these ions to the XESD process.

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