Photon Stimulated Desorption Applied to State Transitions

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A core electron excitation process in a molecule adsorbed on a surface can lead to a bond breaking and subsequent desorption of ions or neutral species. The corresponding scientific area is called DIET (Desorption Induced by Electronic Transitions). A basic assumption of a DIET process is that it consists of a two-stage process, i.e. a primary electronic excitation followed by an evolution into competing processes: either the bond breaking, if the excitation remains localized long enough on the adsorbate species, or the delocalization of the excitation from the primary location and its transfer to the substrate. The efficiency of a photon-stimulated desorption (PSD) process, therefore, depends strictly on the localization of primary excitation, hence, on the strength of the adsorbate-substrate coupling. As a consequence, a chemisorbed species has lower probability of undergoing photodesorption than the corresponding physisorbed one. The different desorption properties of physisorbed vs. chemisorbed species can be used to determine the adsorption properties of a system besides its dynamical electronic processes. As test system we used benzene adsorbed on Si(111)7×7 in the temperature range 30-300K. In particular, it has been shown how it is possible to follow, by PSD, the transition of benzene from physisorbed to chemisorbed on the silicon surface as a function of temperature.