MONITORING PHOTOINDUCED AND PHOTOCATALYTIC SURFACE REACTIONS WITH TIME, MASS, AND ENERGY RESOLUTION

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Breaking and making of chemical bonds in molecules attached to a substrate constitute the elementary steps of a surface chemical reaction and occur on the ultrafast time scale of nuclear motion. Monitoring these elementary steps is crucial for a detailed understanding of the mechanism of surface photoinduced and photocatalytic reactions. In this work, an experimental methodology that combines surface mass spectrometry with femtosecond pump-probe technique and ultraviolet multiphoton or extreme ultraviolet single photon ionization is employed to decipher the mechanism of surface photoinduced and photocatalytic reactions. The technique relies on the detection of highly unstable intermediate species and final products with time-, mass-, and energy resolution. In the first part of the talk, the photoinduced reaction dynamics of methyl iodide adsorbed on an amorphous cerium oxide ultrathin film is investigated to understand the effect of a non-crystalline surface on the reaction dynamics. In the second part of the talk, the reaction dynamics that leads to the formation of methane and methanol from methyl iodide and water co-adsorbed on a TiO2(110) surface will be presented. The results presented here demonstrate the viability of the employed experimental methodology to decipher complex surface photoinduced and photocatalytic reaction mechanisms.