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Exciton and electron transport in metal oxide and metal-insulator nanostructures WAYNE HESS, ALAN JOLY, Pacific Northwest National Laboratory, MATTHEW HALLIDAY, ALEXANDER SHLUGER, PETER SUSHKO, University College London — Understanding the dynamics of electronic excited states in solids is essential to forming mechanistic models relevant to electron and energy transport in materials. Irradiation of materials by ultraviolet (UV) photons, produces energetic species such as holes and free electrons, that relax to form electron-hole pairs and excitons capable of driving surface and bulk reactions such as atomic desorption. Photostimulated desorption experiments, when combined with ab-initio calculations, can be used to develop models for exciton transport and subsequent excited state dynamics. We use pulsed UV lasers to excite specific surface and bulk states of nano-structured metal oxides and measure velocities of desorbed atoms under controlled conditions. By measuring O-atom kinetic energy distributions, as a function of laser frequency, we demonstrate exciton transport on the surface and in the bulk of metal-oxides. We further interrogate electron and exciton dynamics at the metal-insulator interface of thin CsBr films grown on Cu(100). Photoexcitation at 6.4 eV specifically excites the CsBr surface exciton which leads to desorption of neutral Br-atoms with hyperthermal kinetic energies. In dramatic contrast, we observe thermal energy Br atoms from CsBr grown on Cu. The hyperthermal desorption channel is entirely quenched for UV laser desorption of Br atoms even for thick (>60 nm) CsBr films on Cu. Possible models for electron transport and exciton relaxation will be discussed.

Wayne Hess
Pacific Northwest National Laboratory

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