USING SPECTROSCOPY TO SHED LIGHT ON ELECTRONIC MATERIALS PROCESSING

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As microelectronic device dimensions shrink, the challenge of developing next-generation devices depends increasingly upon a detailed understanding of the surface reactions that control the growth and processing of these materials. In this presentation, I will describe the application of both surface and gas phase spectroscopies to monitor such reactions in two semiconductor systems. In the first case, in situ diagnostics are used to identify and monitor gas phase free radicals and surface species in the hot-wire chemical vapor deposition of amorphous silicon thin films. Single-photon vacuum ultraviolet photoionization was used for simultaneous detection of Si, SiH_x, and $Si_2\mathrm{H}_x$ species present in the gas, while surface hydrides were monitored by multiple internal reflection infrared spectroscopy. The second application is in the development of synthetic strategies to control the interfacial bonding at hybrid organic/semiconductor interfaces, for uses such as microchip-based sensors. Here, bifunctional organic molecules are covalently attached at the Si(100), Ge(100), or C(100) surfaces in vacuum. Surface cycloaddition reactions, including the Diels-Alder reaction, are shown to occur readily between unsaturated hydrocarbons and the surface, providing an important route to semiconductor surface functionalization. Again, the use of high resolution infrared and x-ray spectroscopies proves critical to understanding these chemical systems.