403f Organic Monolayer Deposition on Aerosolized Silicon Nanoparticles

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Organic monolayers are assembled on aerosolized silicon crystals of 12 nm mobility diameter under atmospheric pressure and at moderate temperatures (200-400 ºC). The particles are extracted from a low pressure silane plasma. The extracted particles, which have diameters ranging from 6 to 30 nm, are passed through a differential mobility analyzer (DMA), which is set to transmit only those particles having 12 nm mobility diameter. The resulting monodisperse aerosol is allowed to react with a gas-phase organic compound, such as tert-butylamine, hexene, or hexyne. When the aerosol/vapor mixture is heated to moderate temperatures (200-400ºC, depending on the precursor used), organic layers form on the surface of silicon particles. The layer thickness, which is measured directly with tandem differential mobility analysis (TDMA), increases with increasing organic vapor pressure and/or residence time until a compact monolayer is formed. High-resolution transmission electron microscopy (TEM) is used to study the morphology of the silicon particles and the thickness of the deposited organic layers. The possible carbon- or nitrogen-silicon linkage on the surface of aerosolized silicon nanoparticles is also investigated by using infrared spectroscopy. The present study shows a direct measurement for thin film coating on aerosol particles when the film thickness can be controlled by varying the reaction conditions. The organic modified silicon particles can be used for applications such as quantum dots, bio-sensors, and semiconductors.