Thin Solid Films 517 (2009) 3484–3487

Composition and crystallinity of silicon nanoparticles synthesised by hot wire thermal catalytic pyrolysis at different pressures

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ABSTRACT

The effect of pressure on the structure and composition of silicon nanoparticles synthesized by hot wire thermal catalytic pyrolysis (HW-TCP) of pure silane has been investigated. Light brown powders were produced at silane pressures of 10 and 50 mbar, at a flow rate of 50 sccm, using a tungsten filament at temperatures of 1900 °C and 1800 °C respectively. As determined by transmission electron microscopy and Xray diffraction, the particles produced at lower pressure have sizes around 10 nm, whereas those produced at higher pressure are typically 50 nm. High resolution transmission electron microscopy (HR-TEM) shows a surface layer of between 2 and 5 nm thickness, which was confirmed by X-ray photoemission spectroscopy to be an oxide shell. Both X-ray diffraction and HR-TEM confirm a high degree of crystallinity in both sets of particles, with Raman spectroscopy indicating an increase in crystalline fraction with synthesis pressure.