Shape-Controlled Grown Au(Sn)-SnO_2 Core-Shell Nanocables via Vapor-Liquid-Solid (VLS) Growth Mechanism

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Vapor-liquid-solid (VLS) mechanism is the most popular way that used to grow metal oxide nanomaterials, including nanowire (NW), nanobelt (NB) and nanocable (NC), with different growth condition via vapor transportation method. Since metal-metal oxide heterostructures process many unique properties in optical and electrical device performances that systemic investigation preparation parameters are necessary.

Gold (Au) is usually utilized as catalyst because it can form eutectic alloy with lots of metals at low temperature. SnO_2 is a n-type semiconductor with wide band gap, 3.6 eV at 300 K and high response for gas sensor. In order to realize that the growth mechanism of SnO_2 NWs, NBs and NCs, Au NPs with different size are used as catalyst to grow SnO_2 nanowires and Au(Sn) nanocables. Moreover, growth temperature and ambiance are optimized to grow various products, such as NBs, NCs and peapods NWs.

The process was performed in a three-zone tube furnace that was used to heat the quartz tube. Au nanoparticles were dispersed on a Si substrate with 350 nm silica capping layer, Sn vapor was provided by Sn powders at elevated temperature. SEM and TEM are employed to characterize structure and morphology of products. Further, in-situ heating TEM was used to investigate the growth mechanism of different products. Figures 1(a)-(d) are TEM images of different kind products with various growth conditions.

In summary, Au(Sn)-SnO_2 core-shell nanocables were produced by using an one-step approach and relatively lower reacting temperature during the processes. Moreover, the morphology of products is controllable and the growth mechanism is studied.

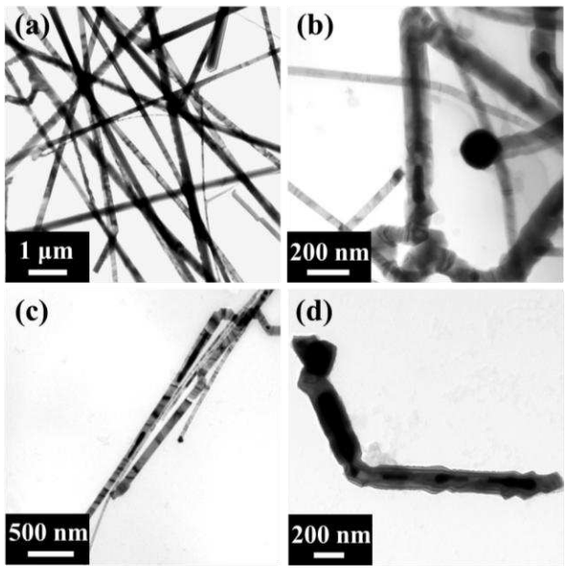

Figure 1. (a) SnO_2 nanowires, (b and c) Au(Sn)-SnO_2 core-shell nanocables, and (d) peapods Au(Sn)-SnO_2 nanowires.

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