中文摘要

本研究利用商業用低成本鋁材，經過一步驟式之陽及處理方式，製得高品質之奈米模板，同時利用真空壓鑄法將錫金屬液注入奈米模板內，使之形成單晶錫奈米線，高效率之奈米線製程，可於十分鐘內完成。利用鋁陽極處理膜(AAO)為奈米模板，於準確的實驗條件控制下，製作奈米線、奈米晶體、奈米球、奈米顆粒、和奈米鬚晶等奈米材料。AAO 之製作乃以一般純度(99.7%)之商用鋁板(#1070)為基材取代傳統需以高純度(99.999%)鋁板的要求，商用鋁板經電化學製程後，表面形成具高孔隙度、均一孔徑、規則孔洞分佈之高品質奈米模板薄膜，隨著製程條件之不同，可製得 15 nm、60 nm、與 180 nm 等不同孔徑之 AAO。真空壓鑄法將熔融之錫(Sn)湯注入 AAO 模板內，待之凝固後，奈米錫線可於 AAO 內形成，由於錫於 AAO 表面具有高的接觸角(contacting angle)特性，當奈米錫線/AAO 複合材料(composite)經不同之熱處理後，錫可於 AAO 表面上形成奈米晶體、奈米球、奈米顆粒、和奈米鬚晶等奈米材料。AAO、奈米線、與奈米球之形成機構分別以電化學和熱力學解釋之。

Abstract

This study used a low price of commercial aluminum foil through one step anodization process making a high quality nanotemplate. Then, the single crystal of tin nanowires were fabricated by a high efficiency method of vacuum hydraulic injection process. Using anodic aluminum oxide (AAO) as a template to fabricate nanomaterials of nanowires, nanocrystals, nanospheres, nanoparticals, and nanowhiskers under the well controlling. A high quality of the AAO templates with high pore density, uniform pore diameter, and ordering nanochannels arrange were fabricated by the electrochemical process. The AAO substrate of general-purity (99.7%) commercial aluminum was used instead of the high-purity (99.999%) aluminum required in conventional anodization. The various AAO pore diameters of 15 nm, 60 nm, and 180 nm were used as the templates to fabricate Sn nanowires by the vacuum hydraulic force injection process. Also, based on the AAO templates and various temperature controlling, low melting temperature metal of tin (Sn) nanowires, nanocrystals, nanowhiskers, nanoparticles and nanospheres were formed inside/on AAO by various processes. The mechanisms of AAO, nanowire, and nanosphere forming were discussed and explained using the electrochemistry and thermodynamics.