

Nanoengineering of tin-based layers

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Abstract

The main task of science is to understand the nature of materials and the means of controlling their behavioral state. Precise controlling of the formation and chemical composition of the thin layer during its growth plays a crucial role in the further implementation of this layer in various devices as an active building block. A metalorganic chemical vapor deposition (MOCVD) method on planar Si surfaces using a nature similar "volcanic eruption" effect is employed to grow unique Sn:SiO₂ nanostructures. An intense oxygen exchange reaction between the planar silicon surface and a thin layer of tin (IV) oxide during MOCVD was observed in a narrow temperature range of 725-735°C, leading to the formation of a unique Sn:SiO₂ composite layer with nature similar shapes as "volcanoes" as shown in Fig. 1a [1]. In the second system, the temperature gradient along SiNWs and the reaction of precursor by-products, provide selective phase distribution along tin oxide nanowire as shown in Fig. 1b [2,3]. Theoretical calculations, wide-ranging surface and bulk sensitive techniques partly synchrotron-based X-ray photoelectron and X-ray absorption spectroscopy have been applied to study the formation mechanisms of unique tin-based nanostructures. These discoveries open a new way to deposit unique Sn-based functional materials and enable the tuning of their functional properties in various scenarios such as photocatalysts, Li(Na)-based batteries, perovskite solar cells, and thermal energy storage.