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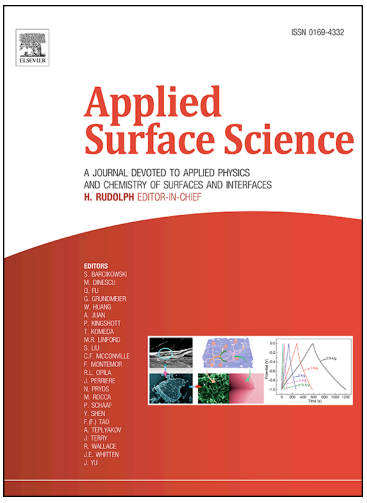

Full Length Article

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Molten salt synthesis of oxygen-deficient SnO_2 crystals with enhanced electrical conductivity

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Abstract

Spiky polycrystalline SnO_2 balls assembled from pyramid-shaped SnO_2 nanocrystals with surface oxygen vacancies were synthesized by a simple and facile in-situ molten salt oxidation method using $SnCl_2$ as tin source and graphite as surface reductant. In this method, perfect SnO_2 nanocrystals are first formed on the surface of graphite particles at 500°C. By increasing the processing temperature to 700°C, the formation of surface oxygen vacancy defects was confirmed, supported by various characterization methods including Raman and XPS spectroscopy. A sharp increase in the bulk electrical conductivity of the samples was detected by exceeding the onset temperature corresponding to the formation of oxygen deficient SnO_2 crystals, at which the conductivity of the sample significantly outperformed that of commercial SnO_2 nanoparticles. The formation of oxygen vacancies on SnO_2 crystals is thermodynamically studied, and suggested to occur by surface carbon reduction of the crystals at sufficiently high temperatures. The enhanced electrical conductivity of oxygen deficient SnO_2 crystals can lead to a wider application of tin oxides in advanced electrical applications.

Key words: SnO_2 crystals; Oxygen vacancy; Molten salt; Electrical conductivity

1. Introduction

Tin oxide (SnO_2), as a wide band gap n-type semiconductor (E_g=3.6 eV at room temperature) is of