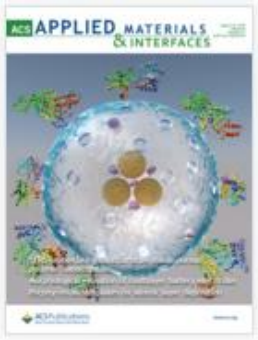

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Sacrificial Template Synthesis and Properties of 3D Hollow-Silicon Nano- and Microstructures

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Abstract

Novel three-dimensional (3D) hollow aero-silicon nano- and microstructures, namely, Si-tetrapods (Si-T) and Si-spheres (Si-S) were synthesized by a sacrificial template approach for the first time. The new Si-T and Si-S architectures were found as most temperature-stable hollow nanomaterials, up to 1000 °C, ever reported. The synthesized aero-silicon or aerogel was integrated into sensor structures based on 3D networks. A single microstructure Si-T was employed to investigate electrical and gas sensing properties. The elaborated hollow microstructures open new possibilities and a wide area of perspectives in the field of nano- and microstructure synthesis by sacrificial template approaches. The enormous flexibility and variety of the hollow Si structures are provided by the special geometry of the sacrificial template material, ZnO-tetrapods (ZnO-T). A Si layer was deposited onto the surface of ZnO-T networks by plasma-enhanced chemical vapor deposition. All samples demonstrated p-type conductivity; hence, the resistance of the sensor structure increased after introducing the reducing gases in the test chamber. These hollow structures and their unique and superior properties can be advantageous in different fields, such as NEMS/MEMS, batteries, dye-sensitized solar cells, gas sensing in harsh environment, and biomedical applications. This method can be extended for synthesis of other types of hollow nanostructures.