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Research note

A facile and fast route to prepare antimony (Sb) nanostructures without additives

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Abstract Herein, we report a safe, low cost and reproducible approach for the synthesis of antimony (Sb) nanostructures with most of them having prism like morphology and having well defined faces in the range of ∼70–210 nm. The organics free approach is based on a reaction of antimony powder and pure water at ∼210 °C without using any harmful additives and amines. The XRD pattern confirmed the composition and crystallinity of the grown nanostructures. The reported method besides being organics free is economical, fast and free of pollution, which will make it suitable for large scale production. Furthermore, it is well expected that such a technique could be extended to prepare many other important metal and metal oxide nanostructures. The prospects of the process are bright and promising.

1. Introduction

Antimony (Sb) is a semimetal and is widely used as a fire retardant in plastic industry, as enclosures of electric devices and as a catalytic agent in organic synthesis. It is also reported to have enhanced thermo electric effect in nano dimensions comparing with their bulk counterparts [1]. But the requirements of simple and reliable protocols for the preparation of nanomaterials in general and antimony in particular with controlled morphology continue to be a major challenge in nanosciences [2]. Among various morphologies fractal structures are being reported and are particularly attractive because they are generally observed in the far from equilibrium growth phenomenon. Fractal growth phenomena are also closely related to many process of practical importance [3].

Antimony (sb) nanostructures were mostly prepared by the electro deposition, solvothermal and soft assembly techniques [4,5]. Number of synthetic additives or capping agents such as polyvinylpyrrolidone (PVP), polyvinyl alcohol (PVA) or sodium polyacrylate has been reported to be used during synthesis of Sb nanomaterials in above techniques. Nanoparticles of Sb and Sb_2O_3 were prepared using structure directing surfactant cetyltrimethylammonium bromide (CTAB) in a controlled condition [6]. In addition, the pathways suggested by others involve environmentally malignant chemicals which are not only toxic and also environmentally hazardous. Therefore, it is imperative to explore new routes which are free from toxic organics and amines. Moreover, it is also now well established fact that the interaction between inorganic nanoparticles and biological structures are one of the most promising areas in nanotechnology and as such there is an urgent need to develop green approaches for nanomaterials that should not use toxic chemicals in the synthesis protocol.

In this short communication, we present a safe and economical approach for the preparation of Sb nanostructures using pure water as solvent. Since water has been used as solvent, we believe that the nanostructures are safe and environmentally benign. To the best of our knowledge and belief, the synthesis of Sb nanostructures without organics or toxic solvents has not been reported in the literature so far. The formation of nanostructures by the reaction of metals with water is suggested to occur due of decomposition of water by the metal giving hydrogen. The advantage of preparing nanoparticles with this method includes ease, flexibility and cost effectiveness.

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