PbTe Nanostructures: Sonochemical and Hydrothermal synthesis with the aid of a Novel Capping Agent

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Synthesis of nano-sized lead telluride (PbTe) as a member of chalcogenides family has attracted significant attention due to its small band gap (0.31 eV at 300 K) and larger Bohr excitation radius. PbTe nanostructures as semiconductors have been widely applied in many fields, such as infrared detectors, photo resistance, lasers, and thermoelectric materials. Up to now, various methods have been explored to synthesize lead telluride nanostructures.

Here, a new Schiff-base compound derived from 1,8-diamino-3,6-dioxaoctane and 2-hydroxy-1-naphthaldehyde was synthesized, characterized, and then used as capping agent for the synthesis of PbTe nanostructures. Lead nitrate, Te powder, $N_2H_4.H_2O$, and NaOH as starting reagents and ethylene glycol as solvent were used in hydrothermal and sonochemical synthesis of PbTe nanostructures. The effect of reaction time and temperature in hydrothermal approach and sonication time in sonication treatment on the morphology and particle sized of the products have been studied. The as-produced PbTe nanostructures were characterized with the aid of XRD, SEM, TEM, EDS, and FT-IR. Based on the obtained results, it was found that pure cubic phased PbTe nanostructures have been obtained by hydrothermal and sonochemical approaches. Besides, SEM images showed that cubic-like and rod-like PbTe nanostructures have been formed by hydrothermal and sonochemical methods, respectively. Sonochemical synthesis of PbTe nanostructures was favorable, because the synthesis time of sonochemical method was shorter than that of hydrothermal method. SEM images of the PbTe synthesized via hydrothermal route at 180 ^{o}C for 6 h (sample H2). Synthesis of very fine nanostructures including nanorods has been took place under the as-mentioned conditions. The particles are agglomerated, and it is difficult to measure the individual particle size with the aid of SEM images. TEM images of the sample H2 were taken and presented in Figs. 1a and 1b. Appling hydrothermal process at 180 ^{o}C for 6 h led to the formation of PbTe nanorods with diameters ranging from 10–12 nm and lengths from 50–70 nm (Fig. 1).

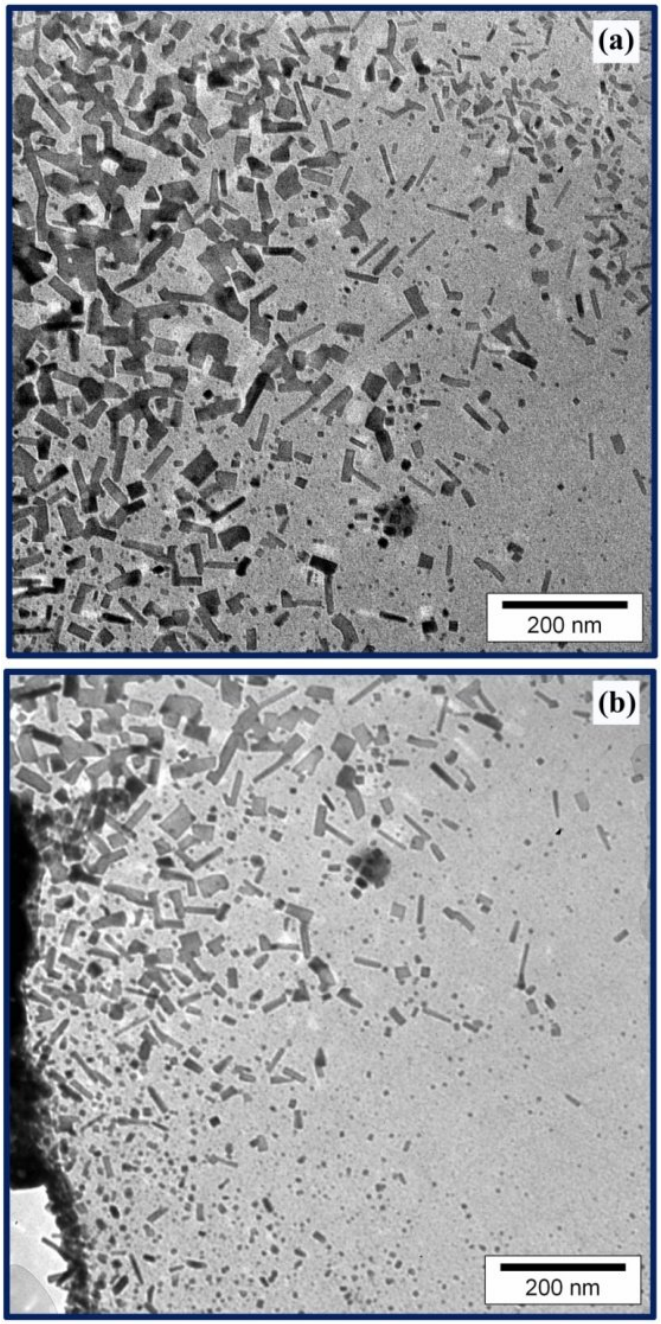

Fig. 1. TEM images of the sample H2 (a, b).