HgTe Nanorods: Hydrothermal Method for Synthesis in Presence of a Novel Precursor

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Most studies in II-VI area have been considerably on zinc and cadmium compounds. The principle studies of mercury compounds are less, due to the high toxicity of mercury. However, mercury telluride nanoparticle is one of the candidate materials for suggesting prospective applications in optoelectronic devices, operating in the wavelength area of 1 to 30 μm, including photoconductive devices, photovoltaic cells, infrared emitters, and infrared detectors. The existing mercury chalcogenide nanocrystal syntheses that have been reported largely deal with solvothermal or solvent-based approaches for making these compounds. These approaches entail sonochemistry, microwave-assisted heating and the thermolysis of common mercury precursors. Recently, the hydrothermal method has also been reported to prepare metal chalcogenide nanostructural materials, which has the potential advantages of relatively low cost, high purity and controlled morphology. In our group, for a few years we have been interested in the synthesis of different type of nanomaterials with new routes by using new inorganic precursors. To the best of our knowledge, this is the first report on the synthesis of HgTe nanostructures via the hydrothermal method by using Hg(salen).

In the present paper, we successfully prepared HgTe nanostructures via hydrothermal route by employing Hg(salen) as a mercury source, $TeCl_4$ and $N_2H_4.H_2O$ as the starting reactants at 180 °C for 12 h. Some factors which affecting the morphologies of the HgTe nanostructures, such as the reaction temperature and time, capping agent, sorts of reductants and alkaline, were systematically investigated. X-ray diffraction analysis (XRD), scanning electron microscope (SEM) and transmission electron microscopy (TEM) images indicate phase, particle size and morphology of the products. Chemical composition and purity of the products were characterized by X-ray energy dispersive spectroscopy (EDS). UV-visible was used to study the optical properties of HgTe samples. Fig. 1 shows TEM images and selected-area electron diffraction (SAED) patterns of the as prepared HgTe nanoparticles by hydrothermal method. The TEM images of the as synthesized HgTe nanoparticles are shown in Fig. 1a and b. The particle sizes of the samples estimated from the TEM pictures is found to be increased from 9 nm to 18 nm. The crystallites are nearly spherical shaped. The SAED pattern of the nanoparticle has shown in Fig. 1c. The diffraction dots can be indexed as the cubic-structural HgTe, which is in good agreement with the result of XRD. Therefore, the nanoparticles can be identified as crystalline cubic HgTe. The systematically investigations showed that the reaction temperature and time, capping agent, sorts of reductants and alkaline could strongly affect the morphology of the final product (Table 1). The as-synthesized mercury telluride nanostructures show HgTe with cubic phase without any other impurities. From the results of XRD and TEM, the HgTe nanostructures show relatively good morphologies corresponding to nanosize about 9– 18 nm. In comparison to other similar works, the current method is simple, is of low cost and can be scaled-up. To the best of our knowledge, it is the first time that [Hg(salen)] is used as precursor for the synthesis of mercury telluride.

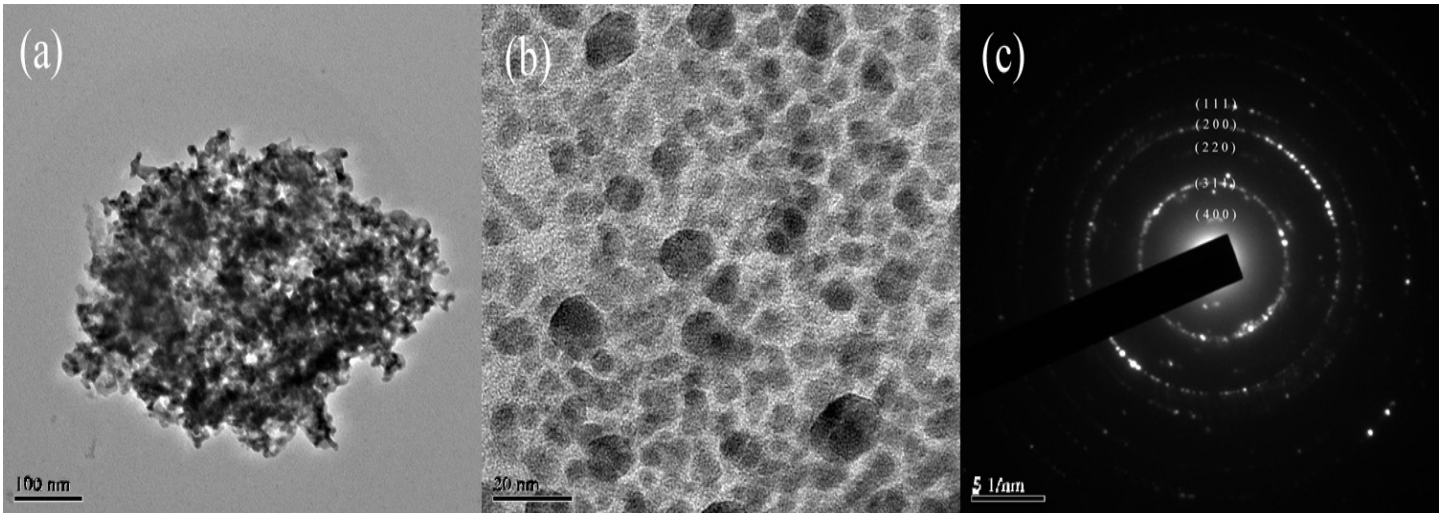

Fig. 7. (a) and (b) TEM and (c) SAED images of the as-synthesized HgTe nanoparticles using the EDTA at 180 °C for 12 h.