CHAPTER 5

CONCLUSIONS AND SUGGESTIONS

5.1 ZnTe by microwave plasma

Cubic ZnTe nanocrystals were successfully produced by an inexpensive solid-state synthesis using a 900 W microwave plasma. The chemical reaction of 1:1 and 1.5:1 molar ratios of Zn:Te conditions were proceeding for 40 min. To save energy consumption, the 1.8:1 molar ratio of Zn:Te and 20 min were used. The phase, nanocrystals and its longitudinal optical modes of 1LO, 2LO and 3LO were clearly detected for the products produced using 1:1 molar ratios of Zn:Te for 40 min. The 1:1 molar ratio of Zn:Te product was composed of 73.37 nm facet nanoparticles with different orientations. But for the 1.5:1 and 1.8:1 molar ratios of Zn:Te products, they were composed of a number of irregular nanoparticles in clusters. Their photoluminescence was the same green emission centered at 562 nm (2.21 eV), possibly associated with point defects at 0.4 eV above the valence band edge.

5.2 Sb_2Te_3 by microwave plasma

Sb_2Te_3 with a rhombohedral crystal system was successfully synthesized by an environmentally benign process with a short reaction time using a 900 W irradiated microwave plasma. At 2:2, 2:1.75, and 2:1.5 molar ratios of Sb:Te, with time lengths of 10 and 20 min, the products were pure Sb_2Te_3 phase with no detection of any residues. Their four Raman shifts were at 93.9, 102.6, 139.2 and 263.7 cm^{-1}, and the direct energy gaps were determined to be 0.340–0.515 eV.

5.3 Ni_3GaSb and Ni_3InSb by alloying preparation in a furnace

In the present study, the Ni_3GaSb and Ni_3InSb compounds were successfully synthesized. Their XRD patterns and lattice parameters were in good accordance with the previously reported data. The crystal structure was hexagonal with the space group of P63/mmc. The electrical resistivity (ρ) and Seebeck coefficient (α) were determined from room temperature to 1073 K. The ρ of both compounds increased with temperature, indicating a metal-like behavior. The α values were negative for both samples and the absolute values were quite low (<10 μVK^{-1} at room temperature for both compounds), like metals. Ni_3GaSb exhibited the lower ρ and absolute α values than those of Ni_3InSb, most likely due to the larger carrier concentration of Ni_3GaSb than that of Ni_3InSb. The power factor increased with temperature and reached a constant value at around 900 K. The κ and ZT values of both samples were increased with temperature as well. In particular, the maximum values of the ZT of Ni_3GaSb and Ni_3InSb were 0.022 and 0.023 at 1073 K, respectively.

5.4 Suggestions

1) Microwave plasma system was able to continuously operate for the length of time, because the microwave oven system; especially, conventional microwave oven often stopped working - batch running, when its inside chamber was heated up until reaching a certain temperature. Thus microwave oven system should be developed in such a manner that it can work continuously or even longer in order to increase its performance.

2) The vacuum pressure of 4.3±1 kPa in the microwave plasma system for the present research was used. If the pressure was reduced to be lower than 4.3±1 kPa, it would be possible to achieve the higher heating rate and the time for the synthesis would be shortened. The present process will lead to save both the time and energy, and the products will have their size with nanoscale as well.

3) If it is possible, the actual temperature during the microwave plasma synthesis should be measured.

4) The present microwave plasma system is able to be modified for the synthesis of different materials, such as oxides, chalcogenides, diamond like carbon, and thin films.