Influence of solvents and irradiation time on structural and optical properties of cubic PbS nanoparticles

ABSTRCT

In the present paper, different particle sizes of lead sulfide (PbS) nanoparticles with a cubic structure were successfully prepared using a microwave irradiation method from lead acetate [$(CH_3COO)_2Pb.3H_2O$] and thioacetamide (CH_3CSNH_2) as the starting materials. Ethylene glycol ($C_2H_6O_2$), distilled water (H_2O), ethylene alcohol (C_2H_5OH) and isopropanol (C_3H_8O) were used as solvents and a 650W oven operating at 20% of the nominal power in the period of 10 min was employed. The effect of the microwave irradiation time was investigated by varying the irradiation time from 10 to 50 minutes respectively. The resulting nanoparticles in different sizes were characterized using X–ray diffraction, Transmission electron microscopy (TEM) and UV–Vis absorption spectroscopy. The crystallite sizes were calculated from the broadening of the XRD peak using Scherrer's equation. The results showed that the increased intensity of the XRD peak and the dipole moment of the solvents being decreased corresponded with the reduction in particle sizes. The TEM results indicated that the samples consisted of separated, well–defined spherical particles and showed a small distribution size. As can be seen from the UV–vis spectrum, the band gap energy of each sample had increased and showed a characteristic blue shift due to the quantum confinement in their optical absorption. The mechanism that influenced the solvents and irradiation time for the formation of the PbS nanoparticles were discussed.

Keyword: Lead sulfide; Solvents; Nanoparticles; Microwave Irradiation; Band gap energy