

Microwave irradiation effects on hydrothermal and polyol synthesis of ZnS nanoparticles

ABSTRACT

Cubic structure of spherical ZnS nanoparticles with relatively small size and narrow size distribution were synthesized via microwave-hydrothermal (M-H) and microwave-polyol (M-P) methods from zinc acetate and thioacetamide as starting materials. Distilled water and ethylene glycol were used as solvents for the M-H and M-P method respectively. To monitor the effect of microwave irradiation, the reactions were carried out in different irradiation time from 5 to 40 min. An increase in irradiation time increases the reaction yield and the average particle size, which subsequently decreases the optical band gap. ZnS nanoparticles synthesized by M-H method have narrower size distribution between 3 and 7 nm, while those synthesized by M-P method were between 2 and 9 nm. Moreover, the formation of hierarchical nanoballs ZnS were observed in the M-H method after 25 min irradiation time. Because of lower dielectric constant, higher dielectric loss, and higher boiling point of ethylene glycol compared to water, in the M-P method the heating rate and final temperature are higher than in M-H method, leading to the decomposition of thioacetamide, promoting higher rate of nucleation. ZnS nanocrystals synthesized with the polyol method have a higher degree of crystallinity compare with those synthesized using the hydrothermal method.

Keyword: ZnS; Nanoparticles; Microwave-hydrothermal; Microwave-polyol; Irradiation time