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Monodispersed chemical synthesis of ZnO nanostructures and effect of annealing on functional properties

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[Introduction]

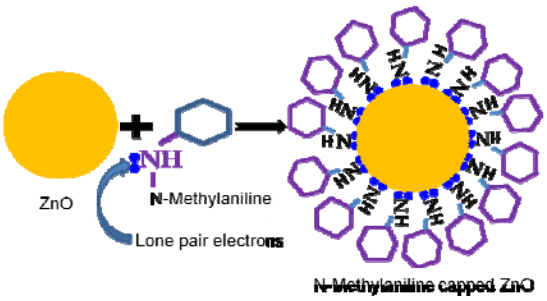
Nanoscale materials exhibit highly enhanced properties, such as optical, electrical and mechanical properties. These properties play an important role in the opto-electronic industries. Size confinement leads to the miniaturization of devices in the modern world. ZnO is a wide band gap (3.3.eV) II-VI semiconductor with a large excitonic energy of 60 meV. Compared to other semiconductors, ZnO is more bio compatible and it has explored for several years owing to wide applications. Synthesis of size confined ZnO nanoparticles with uniform distribution has several difficulties like agglomeration [1], Ostwald ripening and oriented attachment growth of nanoparticles. In the present work, we report a facile synthesis of ZnO nanoparticles with the average size of 8 nm using an amine molecule as a surface passivating agent by wet chemical route. The synthesized ZnO nanoparticles were characterized by XRD, photoluminescence and transmission electron microscope analysis.

[Experimental method]

Synthesis of ZnO nanoparticles is as follows: 0.05 M of N-Methylaniline (NMA) was added into 50 ml of ethanol in a beaker under stirring. 0.2 M of zinc acetate and 0.3 M of sodium hydroxide were added to the NMA – ethanol mixture. The solution was stirred for 10 hours. After that, the precipitates were collected by centrifuging with water and ethanol for several times. Finally, the precipitates were dried at 150 ˚C for 5 hours. The similar reaction parameters were maintained to prepare more samples. The prepared samples were annealed at four different temperatures such as 150, 275, 475 and 600 ˚C for 2 hours.

[Results and discussion]

XRD patterns of ZnO nanoparticles confirm the formation of wurtzite phase and well matched with the JCPDS data – 89-1397. Fig.1. shows the formation mechanism on NMA capped ZnO nanoparticles. TEM and HRTEM images were shown in Figs. 2 (a) and (b) and they clearly depict the formation of monodispersed ZnO nanoparticles with an average length of 8 nm.



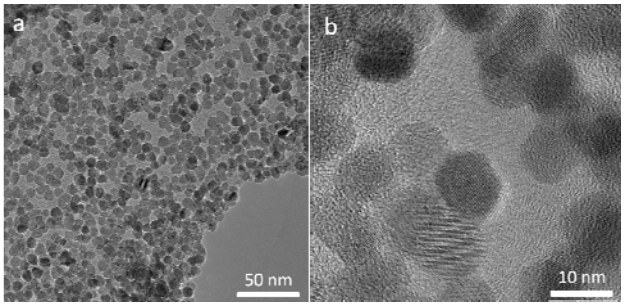


Fig.1 Formation mechanism of NMA capped ZnO.　Figs.2. (a) TEM and (b) HRTEM images of NMA capped ZnO.

References

[1] Ahmad Umar, Caue Ribeiro, A. Al-Hajry, Yoshitake Masuda, Y. B. Hahn: J. Phys. Chem. C 113 (2009) 14715.