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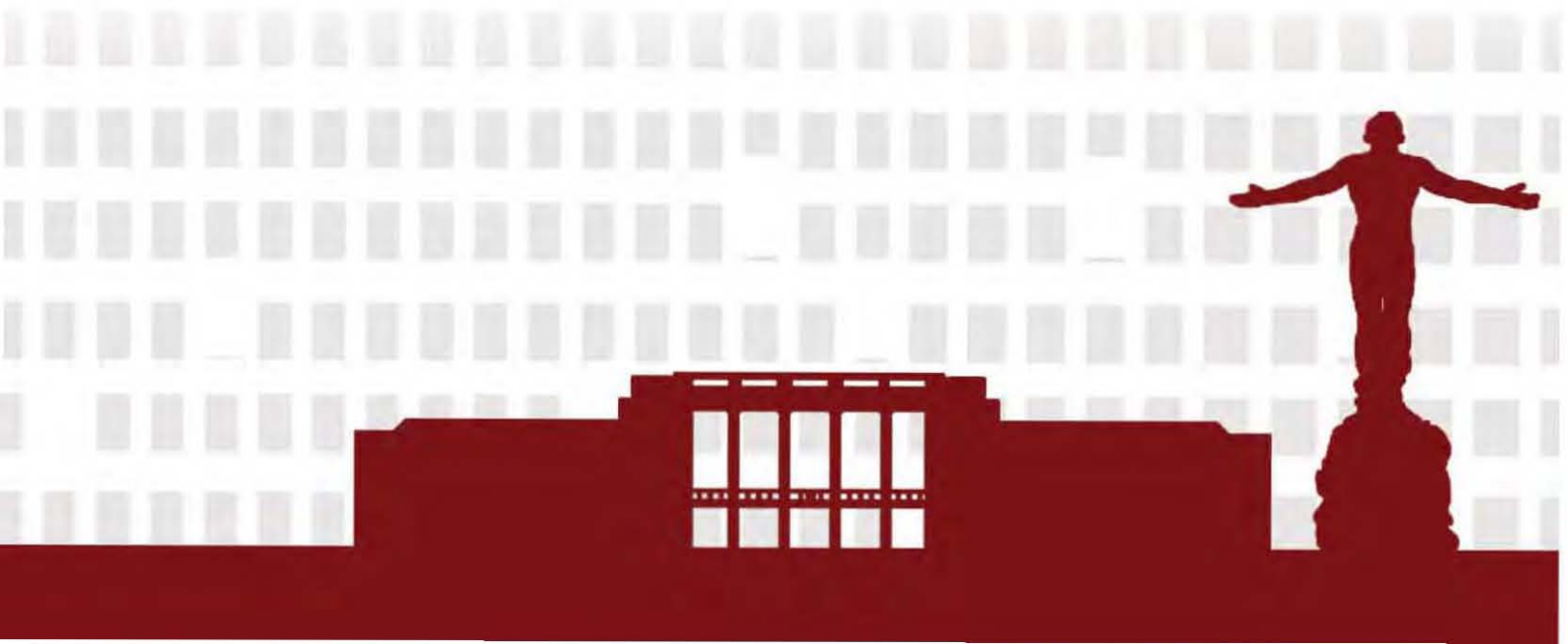
Metro Manila, Philippines



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SYNTHESIS OF ZnO NANOCRYSTALS FOR ORGANIC-INORGANIC HYBRID SOLAR CELLS

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ABSTRACT

In this study, we present the synthesis of ZnO nanocrystals (NCs) by alkaline-activated hydrolysis[1] and condensation of Zn^{2+} and its application for hybrid solar cells. Temperature dependence of the optical and structural properties of ZnO NCs was investigated and its applicability to hybrid solar cells was then examined. In a typical preparation, 6 ml of 0.55M $N(Me)_4OH$ in EtOH was added dropwise to 0.1M $Zn(OAc)_2$ dissolved in 20 ml DMSO under constant stirring at varying temperatures (26-80°C). The nanocrystals were precipitated after 5 min, washed with ethyl acetate and finally resuspended in 6 ml ethanol.

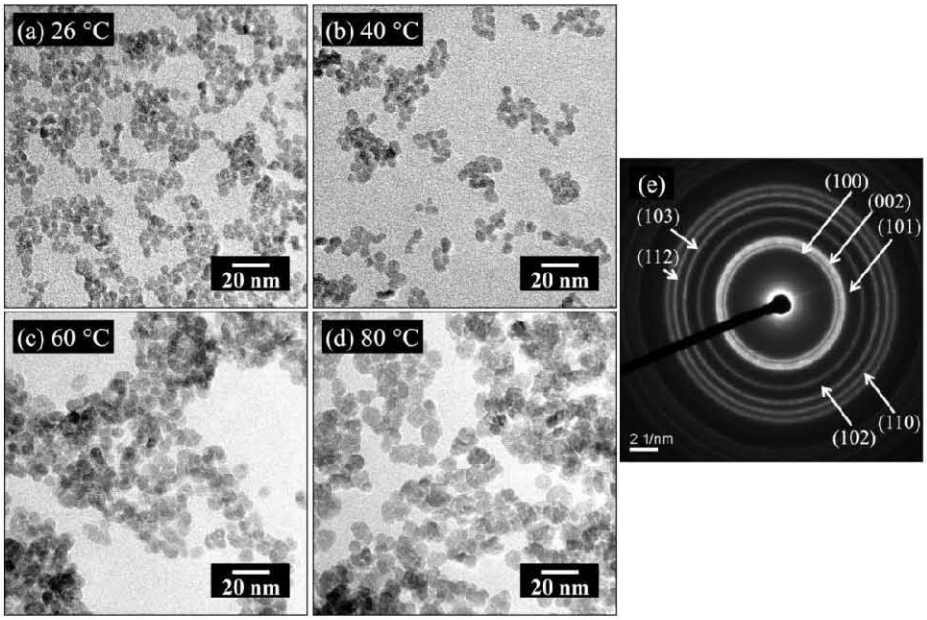

Figure 1. TEM images of ZnO nanocrystals synthesized at different temperatures: (a) 26°C, (b) 40°C, (c) 60°C, (d) 80°C and (e) SAED pattern for 80°C sample.

TEM images of ZnO nanocrystals synthesized at different temperatures are shown in Figure 1. At room temperature synthesis, monodispersed ZnO nanocrystals with a mean diameter of 4.42 nm were formed as demonstrated in Figure 1(a). Increasing the temperature to 40°C, the mean diameter of the nanocrystals increased to about 5.24 nm. As can be observed, the particles have started to agglomerate due to Oswald ripening process. At higher temperatures of 60°C and 80°C, larger particles with mean diameters of 6.70 and 7.73 nm developed, respectively, as seen in Figure 1(c) and 1(d). Figure 1(e) presents the SAED pattern of the sample synthesized at 80°C and the rings are indexed to (100) (002) (101) (103) (112) (102) and (110) crystal planes of hexagonal wurtzite phase of ZnO. Photoluminescence and absorption spectra (not shown here) showed a blue shift to shorter wavelengths indicating quantum confinement and larger band gap at lower reaction temperature.

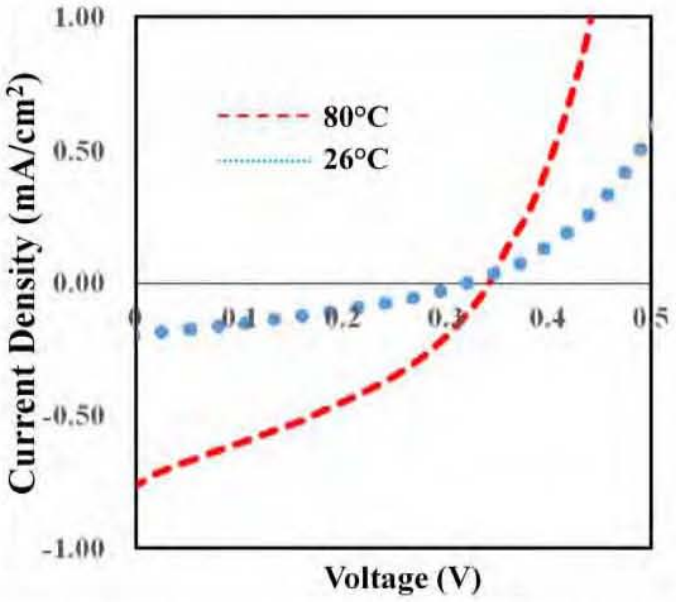

Figure 2. J-V characteristic of the solar cells fabricated from ZnO NCs.

In a separate synthesis, TOPO was used as capping agent for ZnO NCs produced at room temperature and 30 min reaction time. This was used as the first layer of electron acceptor followed by ZnO NCs produced from the previous experiment. Then, P3HT active layer was spin-coated followed by depositing a MoO_3 and Au electrode. The solar cell fabricated from 26°C and 80°C ZnO NCs generated an efficiency of up to 0.02% and 0.09%, respectively.

Keywords: ZnO nanocrystals, Organic-Inorganic Hybrid Solar Cell, Quantum confinement

Reference

[1] Schwartz, D. A.; Norberg, N. S.; Nguyen, Q. P.; Parker, J. M.; Gamelin, D. R. J. Am. Chem. Soc. 2003, 125, 13205.