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Optical and electronic properties of ZnO nanoparticles embedded in polyimide barriers

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Since ZnO semiconductors are large band-gap semiconductors with novel physical properties of large exciton binding energies and excellent chemical stabilities, they have been particularly attractive because of the interest in promising applications in optoelectronic devices operating in the blue and ultra-violet region of the spectrum[1,2]. Self-assembled ZnO nanoparticles embedded in a polyimide (PI) matrix were formed on glass and Si substrates by curing Zn thin films with PI precursor layers. Transmission electron microscopy images showed that ZnO nanoparticles were formed inside the PI layer. Photoluminescence (PL) spectra at 18 K for the ZnO nanoparticles embedded in a PI layer showed that excitonic peaks corresponding to the ZnO nanoparticles and a peak related to the PI layer appeared. The activation energy of the electrons confined in the ZnO nanocrystals embedded in the PI layer, as obtained from the temperature-dependent PL spectra, was determined. X-ray photoelectron spectroscopy spectra showed three peaks corresponding to O 1s, Zn $2p_{3/2}$, and Zn $2p_{1/2}$ appeared. The optical and electronic properties of ZnO nanoparticles embedded in a PI layer were compared with those of ZnO thin films grown on Si substrates. A possible electronic structure for the ZnO nanoparticles embedded in a PI layer was described on the basis of the experimental results. Thess present results can help improve understanding of optical and electronic properties of self-assembled ZnO nanocrystals embedded in PI layer.

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[참고문헌]

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