【NP-10】

Synthesis and characterization of Silicon quantum dots via Wet synthetic chemistry method

박일규, 최상현, 이성훈
광주과학기술원 신소재공학과

We have synthesized and characterized alkyl-terminated silicon quantum dots via wet synthetic chemistry method. This method was based on the metathesis reaction of Zintl salt, Mg2Si, and SiCl4 in organic solvent (Glyme). We have investigated structural and optical properties of silicon quantum dots, using high resolution transmission electron microscopy(HR-TEM), Fourier transform-infrared spectroscopy(FT-IR), UV-Vis. spectrophotometer, and photoluminescence(PL) spectroscopy. Mg2Si was synthesized directly from the elements and its crystalline structure was anti-fluorite structure, which confirmed by powder-XRD. TEM images of quantum dots showed that the size of quantum dots was 2-10nm, which increased as increasing the reflux time. HR-TEM images of each particle showed defects in the dots, which resulted from the low reaction temperature. FT-IR spectrum was consistent with a silicon quantum dot surface that was alkyl-terminated. This implied well controlled surfaces and sterically stabilized quantum dots. UV-Vis. absorption spectra suggested that these quantum dots retained their bulk-like properties. The long wavelength absorption tail associated with the indirect-band gap, and several direct transitions were evident in the spectra. The absorption tails were red shifted with increasing the reflux time, which consistent with the quantum confinement effect. We observed room temperature PL in the UV to blue region of the spectrum and this was attributed to the direct electron-hole recombination at zone center(Γ). This observation of direct recombination in silicon was a consequence of quantum confinement effect.