# Photoluminescence Property of Si-based nanosheet bundles rooted on Si substrates

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**Introduction:** Low-dimensional materials have attracted much interest due to their enhanced or modified optical, electronic and mechanical properties compared to those of bulk materials. A nanosheet bundle is also one of the potential structures for technological applications. The Si-based nanosheet bundles have been synthesized from $CaSi_2$ microwalls on Si substrates. The structural properties of the bundles were characterized in the past [1,2]. In this study, the photoluminescence (PL) property of the bundles is characterized, and the results are discussed in terms of quantum effect and surface states of the nanosheets.

**Experiments:** First, $CaSi_2$ microwalls were grown on Si substrates [3]. Then, Si-based nanosheet bundles have been synthesized from the $CaSi_2$ microwalls on Si substrates by inositol hexakisphosphate (IP6) in an aqueous solution and thermal treatment under $FeCl_2$ vapors. The growth conditions of the microwalls and nanosheet bundles are described elsewhere [1,2]. PL measurements were performed at temperatures between 18 and 300 K within a closed cycle helium cryostat. The signals were detected using a standard lock-in technique with a cw 532 nm second harmonic generation (SHG) Nd:$YVO_4$ laser as the excitation source and an InGaAs photodetector.

**Results and Discussion:** Figure 1(a) and (b) show temperature dependences of the PL spectra of the Si-based nanosheets synthesized by IP6 and $FeCl_2$ treatments, respectively. The small broad emissions around 850 and 1350 nm for the nanosheet bundles synthesized by IP6 are due to radiative recombination from quantum states in two-dimensional (2D) quantum well and its related near-infrared emission. On the other hand, for the $FeCl_2$ treated Si-based nanosheet bundles, small surface radiative recombination peaks, except PL peaks from the Si substrate, appear around 800 − 1600 nm, caused by the bandgap broadening of Si. The quantum confinement effect in 2D nanosheet system is observed for Si-based nanosheet bundles synthesized from $CaSi_2$ crystals.

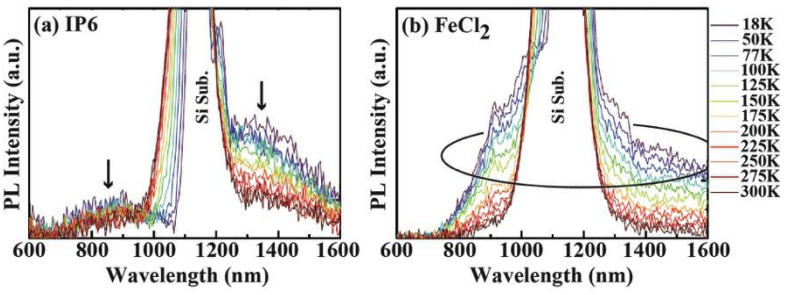


Fig.1 Temperature dependences of the PL spectra of the Si-based nanosheets synthesized by (a) IP6 and (b) $FeCl_2$ treatments, respectively.

**References**

[1] X. Meng, *et al*., Jpn J.Appl.Phys., accepted.

[2] X. Meng, *et al*., to be submitted.

[3] X.Meng, *et al*., Chem. Eur. J., accepted.