第35回 GRL 浜松セミナー

~若手研究者のための光・電子・情報科学に関する情報交換~

Engineering composition bandgap, built-in-charge and interface of silicon nanocrystals for photovoltaic applications

Vladimir Švrček

Research Center for Photovoltaic Technologies, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, JAPAN

2月26日（火）14：00～15：00　@総合研究棟　2F,総204室

Significant research interest in the engineering of solar cells is directed toward lowering the fabrication costs and improving the photoelectric power conversion efficiency. Two methods to improve these characteristics in next-generation solar energy devices will be described. One approach involves use of nanoscale silicon crystals exhibiting quantum confinement effects. In silicon nanocrystals excess energy of absorbed photons, which in bulk silicon is normally lost as heat, can be converted to generate additional charge carriers via carrier multiplication (CM). During this process absorption of photons with energies of at least twice the bandgap energy can produce more than two electron-hole pairs. Another approach involves silicon alloying with other materials for composition bandgap tuning in silicon-compatible devices taking the advantage of the mature silicon technology and an established industrial infrastructure. The silicon-tin($Si_{1-x}Sn_x$) system is an interesting candidate as an optically active material where the concentration of Sn can be effectively used to extend the range of achievable bandgaps below the energy gap of silicon (1.15 eV) .

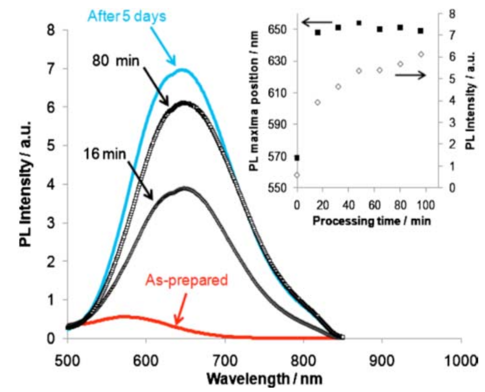

Figure 1. Photoluminescence (PL) spectra of Si-ncs dispersed in ethanol before and after microplasma processing at different processing time, open symbols: PL emission 5 days after processing. (*Appl. Phys. Lett. 100*, 223904, **2012**)

In the lecture we will initially discuss synthesis of Si nanocrystals using short-pulsed laser processing. Laser pulses (ns, fs) incident on the surface of silicon immersed in a liquid medium, generate a spatially confined plasma with high pressure (~GPa), which provides unique kinetic pathways for nucleation and growth of nanocrystals (size < 10 nm) with quantum confinement effects. In the second part, we will focus on charging phenomena at the Si-ncs surface that can significantly improve the conversion efficiency of solar cells. We will illustrate how the pulsed laser process followed by the microplasma treatment result in stabilization of the Si-ncs optoelectronic properties (Fig. 1) while preserving built-in charges. Finally, we will summarize the interface performance of engineered nanocrystals, particularly for photovoltaic devices, by giving perspectives for future developments.

Acknowledgement: This work was partially supported by JSPS and a NEDO projects.

お問い合わせ先: 若手グローバル研究リーダー育成拠点　ミゼイキス　ビガンタス
内線 1312　e-mail: dvmzks@ipc.shizuoka.ac.jp