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ワイドギャップナノ結晶シリコン自立膜セルの光起電特性
Photovoltaic Properties of Wide-gap Nanocrystalline Silicon Membrane Cells

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In recent years, silicon nano-dots based materials have attracted a great deal of attention for their potential application in photonic and electronic devices, especially for advanced solar cells and photo-detection applications. Among the various types of fabrication process, we have been investigating the formation of nano-crystalline Si material (nc-Si) by electrochemical etching for potential application as a wide gap absorber for solar cells[1].

Free-standing thin layers of nc-Si materials were produced by anodization of various single-crystalline Si wafers (p, n, p-n or n-p type) in HF solutions under galvanostatic conditions followed by electrochemical peeling out from the substrate. The resulting free-standing nc-Si membrane cells were fabricated with a metal/nc-Si/metal sandwich configuration as seen in the upper right inset of **Fig. 1(a)**.

Membranes cells made from pn type substrate show photovoltaic characteristics with remarkably high V_{oc}[2] up to 0.87V under AM1.5-1 Sun illumination, due to an increased carrier separation in the devices in contrast to singly doped p and n type membranes. The spectral response was consistent with the widened band gap. The measured short circuit current of a pn membrane cell under light concentration from 1 to 10 Sun is shown in **Fig. 1(b)**. The short circuit current shows a linear behavior with increasing light intensity with no saturation.

Further experimental investigations for enhancing the short circuit current will be reported mainly on the effect of the surface and interfacial passivation of the nc-Si layer.

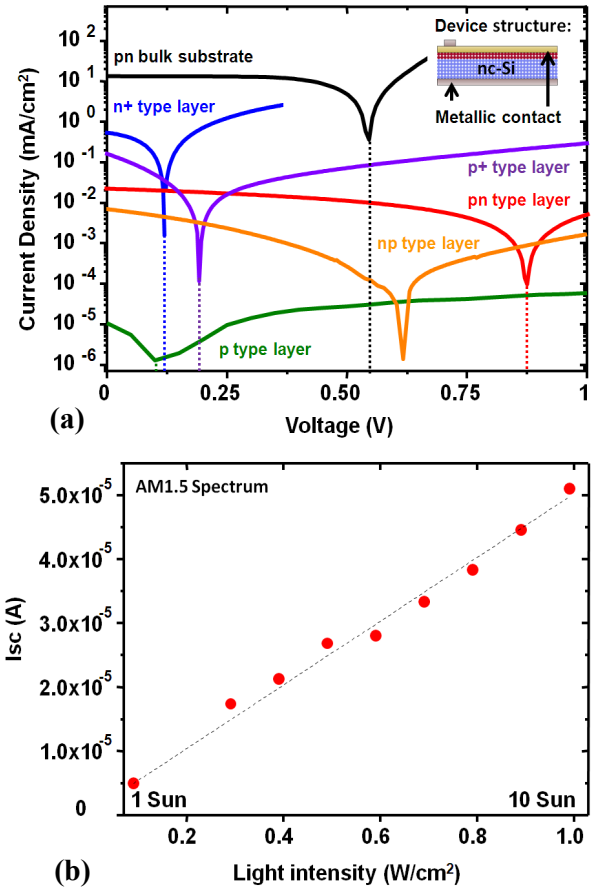

Fig. 1 (a) Comparison of PV characteristics of multiple nc-Si free-standing layers including pn type, singly doped p and n, and nc-Si/c-Si hetero-structure, inset shows the structure of the nc-Si devices, (b) Linear dependence of the short circuit current on the illumination intensity (from 1 Sun to 10 Sun).

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[1] R. Mentek, B. Gelloz and N. Koshida, Jpn. J. Appl. Phys. **49** (2010) 04DG22.
[2] R. Mentek, B. Gelloz and N. Koshida, Jpn. J. Appl. Phys. **51** (2012) 02BP05.