Investigation of correlation between the conductivity increasing of SiN_x thin films by UV light and potential induced degradation

NAIST[1], AIST[2], TTI[3], Dong Chung Nguyen[1], Yasuaki Ishikawa[1], Sachiko Jonai[1,2], Kyotaro Nakamura[3], Atsushi Masuda[2] and Yukiharu Uraoka[1]

[1]*Division of Materials Science, Nara Institute of Science and Technology, Ikoma, Nara 630-0192, Japan*
[2]*National Institute of Advanced Industrial Science and Technology, Tsukuba, Ibaraki 305-8568, Japan*
[3]*Toyota Technological Institute, Nagoya, Aichi 468-8511, Japan*
E-mail:nguyen.chung_dong.na7@ms.naist.jp, yishikawa@ms.naist.jp

Irradiating UV light on p-type crystalline Si (c-Si) solar cells during potential induced degradation (PID) tests can delay the degradation of the solar cell performances [1]. A highly conductive silicon nitride (SiN_x) layer has a significant influence on the PID resistance of p-type c-Si solar cells, suggesting an investigation of the change of the SiN_x properties under UV light irradiation is necessary. This work studied conductivity change in SiN_x thin films under the UV light irradiation. Three SiN_x thin film samples with different refractive indexes (n) were prepared by plasma-enhanced chemical vapor deposition (PE-CVD) method. Band-gap of SiN_x thin films estimated based on the absorption edge method is 3.56 eV (348 nm), 3.18 eV (390 nm) and 2.97 eV (418 nm) corresponding to refractive indexes of 1.95, 2.12, and 2.20 estimated at 600-nm wavelength, respectively. The conductivity of the SiN_x thin films was measured by a two-probe measurement in a vacuum chamber with a pressure of 2.3×10^{-2} Pa with several conditions: an applied voltage of 40 V, light irradiation of similar photon flux of 9.26×10^{14} photon/cm^{2}s at the wavelengths of 300 nm, 370 nm, 390 nm, 460 nm and 500 nm. According to Fig. 1 and Fig. 2, increasing of conductivity and photosensitivity of SiN_x thin films under light irradiation depend on their refractive indexes and are limited by their band-gap. These results are in good agreement with previous results using SiN_x thin films prepared by catalytic chemical vapor deposition method reported by our group [2]. We presume that these increasing of photosensitivity by UV light irradiation is responsible for PID delay effect.

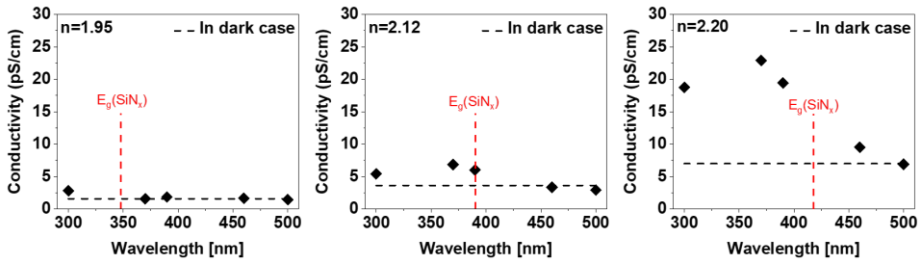

Fig. 1. The conductivity change in SiN_x thin films with different refractive indexes at different wavelength light irradiation.

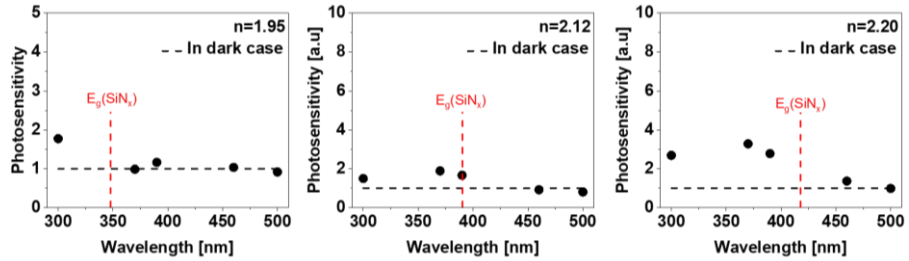

Fig. 2. The photosensitivity change in SiN_x thin films with different refractive indexes at different wavelength light irradiation.

This work was supported by The New Energy and Industrial Technology Development Organization, Japan.

[1]. A. Masuda and Y. Hara, Japanese Journal of Applied Physics, vol. 57, p. 08RG13, 2018.
[2]. D. C. Nguyen et al., The 46th IEEE Photovoltaic Specialists Conference, USA, G11-110, 2019.