Area: Performance and Reliability of PV Modules

EFFECTS OF LIGHT IRRADIATION DURING POTENTIAL-INDUCED DEGRADATION TESTS FOR P-TYPE CRYSTALLINE SILICON PHOTOVOLTAIC MODULES

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Potential-induced degradation (PID) has attracted much attention in recent years since PID brings drastic reduction in output power within relatively short period in mega-watt scale photovoltaic (PV) plant. Although it is considered that Na migration from cover glass is one of possible origins of PID, much effort should be devoted for complete understanding of the mechanism for PID. The most important degradation factor for PV modules exposed outdoors is light exposure. However, only few results have been reported on light irradiation effects on PID.[1)] In this paper influence of light irradiation during PID tests for p-type crystalline Si PV modules will be in detail reported.

PV modules composed of a p-type multicrystalline Si cell with interconnector ribbons, two sheets of ethylene-vinyl acetate encapsulant, polyvinyl fluoride (PVF)/polyethylene terephthalate/PVF triple-layer backsheet, soda-lime cover glass, Al tape instead of Al frame were subjected to PID test. PID test was carried out in the climate chamber at temperature of 85℃ and relative humidity below 10% with and without light irradiation by Xe lamp or UV LED of the wavelength around 370 nm. DC voltage of -1000 V was applied to shorted interconnector ribbons against grounded Al tape.

Figure 1 shows maximum power normalized to the initial value as a function of PID test time. It was found that light irradiation by Xe lamp with intensity above 0.15 SUN during PID test obviously delays the progress of PID and such irradiation effects are saturated at the intensity above 0.3 SUN. It was also found that light irradiation effects require UV components of the wavelength below around 400 nm. Figure 2 also shows normalized maximum power as a function of PID test time for PV modules with shadow. PID test was carried out under light irradiation using UV LED of the intensity of 0.3 SUN. It was observed that PID is accelerated with an increase in the shadowed area. It also turned out that dark electroluminescence images originating from PID appear from the shadowed area.

Voltage is generated only under light irradiation for the PV modules in the field. Therefore indoor PID test in the dark may bring severe artificial degradation in comparison with that observed outdoors. On the other hand, it is also pointed out that PID is easy to occur for the PV modules with partial shadow often observed outdoors.

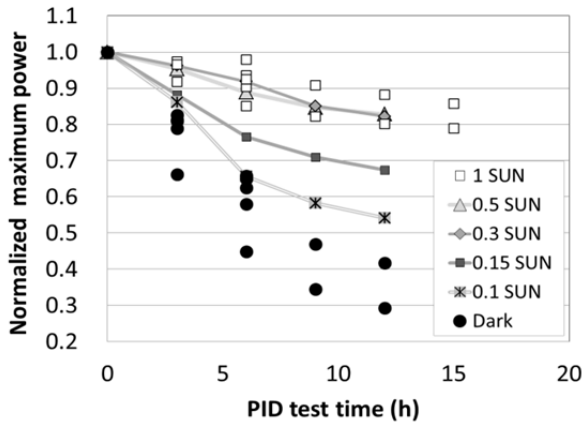

Figure 1: Normalized maximum power as a function of PID test time. PID tests were carried out without or with light irradiation ranging from 0.1 SUN to 1 SUN.

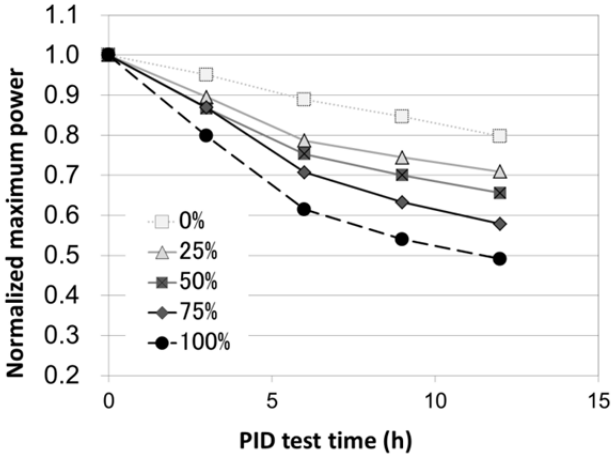

Figure 2: Normalized maximum power as a function of PID test time. PID tests were carried out for PV modules with shadow of area ranging from 0% to 100%.

This work was supported by the New Energy and Industrial Technology Development Organization.

References

1) S. Koch *et al.*, Proc. 28th European Photovoltaic Solar Energy Conf. Exhib., 2013, p. 1665.