Performance and Reliability of PV Modules

ACCELERATION TEST OF COMBINED STRESSES FOR FLEXIBLE SOLAR MODULES

Akihiro Takano, Tetsuro Nakamura, Tetsuya Fukuda, Ayumi Hamada, Hiroki Sato and Masaaki Toda

F-WAVE Company Limited, Japan

Acceleration tests of combined stresses for flexible modules are proposed. We have already developed and reported an acceleration test of damp heat and current injection test. Approximately 3,000h acceleration test corresponds to 20 years outdoor exposure. In this paper, we propose pressure cooker and current injection test for achieving much faster acceleration test.

F-WAVE developed thin film device and production technologies of large-area, light-weight flexible thin film Si solar cells and modules using 1m-wide and 3,000m long heat-resistant plastic film substrates. A unique monolithic device structure having through-hole contacts formed on the flexible plastic film and various roll-to-roll production technologies, such as film depositions and laser patterning, were developed and applied to production lines in our factory. The unique device structure enables us to cut and connect cells easily resulting in easy customizing voltage and current specifications of products. Recently, our business partners are producing various PV modules using our flexible solar cells as shown in Fig. 1.

Damp heat and current injection test duplicates similar defects in solar cells which is observed in the module after long term outdoor exposure. Some encapsulants, such as EVA, were intentionally applied to PV modules. Outdoor exposure tests and damp heat and current injection tests were done using these modules. Figure 2 shows the relationship between test time and acetic acid concentration in encapsulant. The results show that approximately 3,000h acceleration test corresponds to 20 years outside exposure. Figure 3 and 4 show results of damp heat and current injection test (85°C, RH 95%) and pressure cooker and current injection test (105°C, RH 100%). These results prove that much faster acceleration test is achieved.

Figure 1: An example of flexible PV installation. (Weed preventing sheet integrated PV system)

Figure 2: Concentration of acetic acid in EVA layers after damp heat tests. Large circle and square are data of outdoor exposed modules for 3 and 6 years, respectively.

Figure 3: Damp heat and current injection test results of modules having various encapsulants.

Figure 4: Pressure cooker and current injection test results of modules having various encapsulants.