Optical Spectrum Measurement of Arc Plasma on Solar Array for GEO environment

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Background and purpose

As the power level of Geostationary satellites increases, discharge phenomena on solar array are becoming serious threat to safe operation. There is more demand of international standard on ground test conditions (test environment, test circuit, test duration and external capacitance). Especially, the value of external capacitance that feeds energy to the trigger arc is very important. The external capacitance corresponds to the absorbed electric charges on the insulator surface. A low capacitance value doesn't provide a sufficient current to trigger a secondary arc. On the other hand, we must avoid using an excessive value of capacitance that leads to degradation of cell electrical power output. The amount of external capacitor currently employed differs among research institutions. We focused on the relation between the electrical conductivity of the trigger arc plasma and the amount of external capacitor in order to evaluate the range of proper amount of external capacitor. Electrical conductivity is strongly related to plasma temperature. Thus, we measure the plasma temperature by the emission spectroscopy.

Experimental method

A sample coupon has 12 cells with typical size coverglass (7cm x 3.5cm x 100um). All the tests were carried out under the condition of inverted gradient, which coupon was biased negatively and irradiated the electron beam. We used spectroscopy (PMA11C8808-01:HAMAMATSU).

Experimental result

In trigger arc(pulse width : below10us) spectra, identified spectra were hydrogen, Carbon molecular. In secondary arc spectra(pulse width : 10us~100us), identified spectra were hydrogen, Carbon molecular, aluminum and iron. There were clear difference between trigger arc spectra and secondary arc spectra. Especially, C_2 swan band was measured clearly from arc initiation to extinction with good repeatability. Thus, temperature was deduced by relative intensity of each blanch of C_2 swan band. The arc temperatures became low after discharge shifts to the secondary arc.