

# Effect of insulation film on solar array on durability against sustained arc

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## 1. Background & Purpose

Recently, spacecraft is shifting to bigger and multiple functions. However, high voltage generation induces discharges on solar arrays in space. Especially, Permanent Sustained Arc (PSA) directly leads to outage of satellite. Therefore it is necessary to mitigate PSA on the satellite. The effect of the insulation film thickness on PSA inception was investigated [1]. Figure 1 shows the results of the PSA tolerance in different thickness polyimide film [1]. Figure 1 indicates the time until polyimide film gets breaking each thickness. It shows the thicker film could withstands against sustained arc for longer duration. However, the mitigation effect decreased when the film is too thick. The purpose of this research is to clarify relationship the polyimide thickness and mitigation effect to sustained arc.

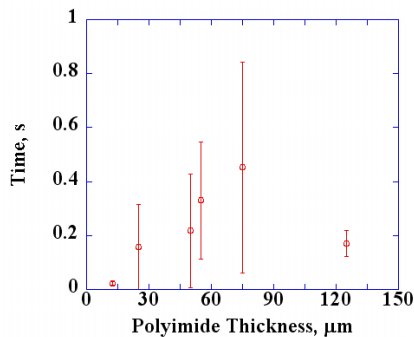


Fig. 1. Relations of time until current flows to structure and thickness of polyimide.\*

## 2. Research method

Sustained arc was observed from the cross section side of sample by high-speed camera (25000fps) with long-distance microscope. The time change of sustained arc shape was observed, and compared with discharge waveform.

The internal transmittance of polyimide (Kapton®) was calculated from reflectance and transmittance of each thickness, and an explicit thermal analysis program using is was developed in C language.

## 3. Result

Figure 2 shows the discharge waveform for a sample with a polyimide film thickness of  $25\mu\text{m}$ , and figure 3 shows the picture of the gap. By comparing this discharge waveform with the photograph of the high-speed camera, succeeded in observing the change of sustained arc.

In addition, thermal analysis was carried out in consideration of the transmittance of polyimide (Kapton®) film. But it was linearly related to the thickness, which was different from test result (figure 1).

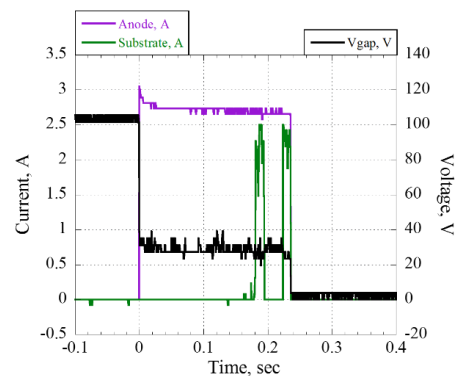
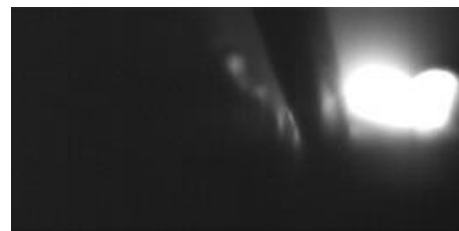


Fig. 2. Waveform (Thickness :  $25\mu\text{m}$ )



(a) 0.16sec



(b) 0.19sec

Fig. 3. Picture of gap when discharge occurred (Thickness :  $25\mu\text{m}$ )

## 4. Reference

\*Wada, T., Toyoda, K.: Research on development and evaluation of mitigation method against sustained arcing on solar array, *Trans. Jpn. Master Thesis*, Kyushu Institute of Technology, Kitakyushu, Japan, 2011