DEGRADATION OF SILVERED COLORLESS-TRANSPARENT POLYIMIDE

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ABSTRACT

The Silvered Teflon® has been extensively used as a flexible radiator material of a spacecraft. However, it is well-known that it becomes brittle and gets cracked when it is exposed to charged particles. A flexible radiator material is much easier to apply compared to a rigid material, e.g. glass, especially for a curved surface. Therefore, a more stable flexible radiator material than the Silvered Teflon® is desired. This paper presents the degradation characteristics of the ITO-coated silver-deposited colorless-transparent polyimide. The ITO-coated silver-deposited colorless-transparent polyimide was exposed to UV, AO and electron beam (EB), and the thermo-optical properties and the surface electrical conductivity are measured and compared with the Silvered Teflon®.

The virgin (not-degraded) thermo-optical property ($\alpha_s/\varepsilon_N$) of the ITO-coated silver-deposited colorless-transparent polyimide was 0.14/0.71, while that of the Silvered Teflon was 0.08/0.85. In the UV irradiation tests, the value of $\alpha_s$ increased to 0.23 after 100 ESD for the ITO-coated silver-deposited colorless-transparent polyimide. This degradation is too high to be ignored, so it should be improved: the UV cut layer should be coated under the ITO layer, for example. In the AO irradiation test of 4.4 x 10^{20} atoms·cm^{-2}, the mass decrease was very small owing to the ITO coating. After the EB irradiation whose total dose was 10MGy, no crack was found in the polyimide layer and the surface electrical conductivity was maintained, although the material had yellowed little.

These tests show that the silver-deposited colorless-transparent polyimide can supersede the silvered Teflon®. The ITO-coated silver-deposited colorless-transparent polyimide is much more tolerant to EB irradiation and much more stable ITO layer compared to the Silvered Teflon®. However, the UV tolerance of the ITO-coated silver-deposited colorless-transparent polyimide is worse compared to the Silvered Teflon® and should be improved.