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Influence of Space Radiation Model Uncertainties on the Thermophysical Properties Evaluation of ITO/Kapton/Al Film

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INTRODUCTION

◆ The ITO/Kapton/Al film as an antistatic thermal control coating with excellent performance is often be used in all kinds of orbit spacecraft.

◆Space radiation model uncertainties may have important influence on the evaluation of thermophysical properties of anti-electrostatics thermal control materials.

◆space radiation environmental model AE-8/AP-8 is accurate to within a factor 2, that is, the uncertainty factor of AE-8/AP-8 model is 2.

◆In order to improve the precision of space environment model, "confidence level" is introduced to evaluate the reliability of the models. For example, AE-9/AP-9 models.

UNCERTAINTY OF SPACE RADIATION ENVIRONMENT MODEL

The uncertainty of these two space radiation environment models mainly comes from the following aspects:

◆The first is the dependence of the model on the solar activity cycle.

◆The second is the transient of space radiation environments.

◆The third is the directionality of space radiation environments.

◆The fourth is the extrapolation of energy.

◆The fifth is the drift of the space radiation environments in the southern Atlantic anomaly (SAA).

The uncertainty of the space radiation environment model can be characterized by the uncertainty factor (UF).

$$UF = \frac{F_f}{F_M}$$

Here:

F_f is the the actual fluence of an space environment , its unit is cm^{-2};

F_M is the fluence of the space radiation environment model, its unit is cm^{-2}.

Relative deviations can be used to characterize the influence of the uncertainty of the space radiation environment model on the property of the test parts.

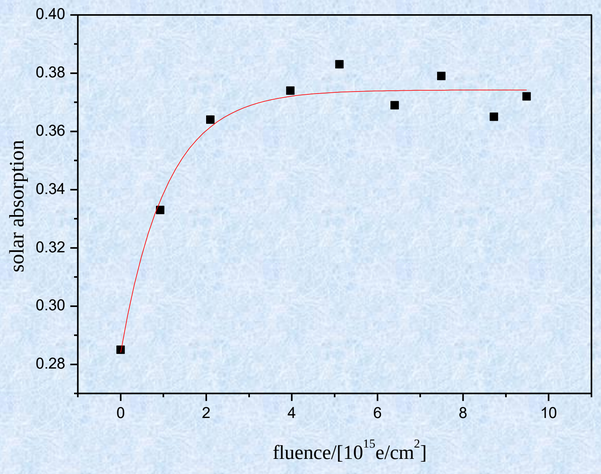
$$\frac{\Delta x}{x_0} = \frac{x - x_0}{x_0}$$

Here,$\Delta x$is the absolute varaity of the measured performance of samples under different uncertainty factors; x_0 is the value of the measured performance when the uncertainty factor is 1; x is the performance of the sample with a certain uncertainty factor except 1.

EXPERIMENTS AND TESTS

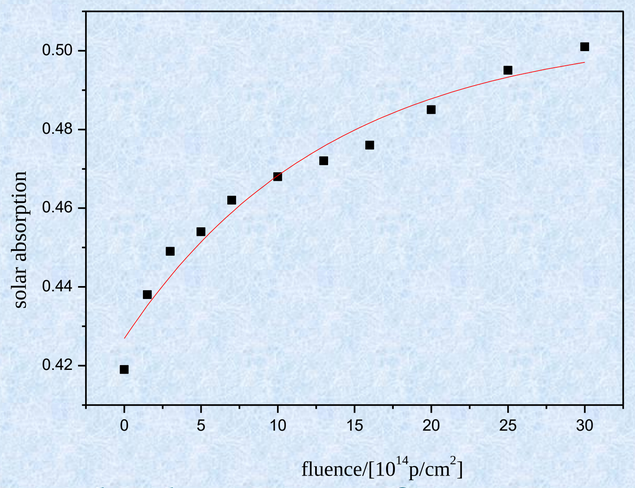
Low-energy combined environment test facility at Beijing Institute of Spacecraft Environment Engineering (BISSE)

THERMAL PROPERTIES



Solar absorptances of ITO/kapton/Al film in different electron fluencies

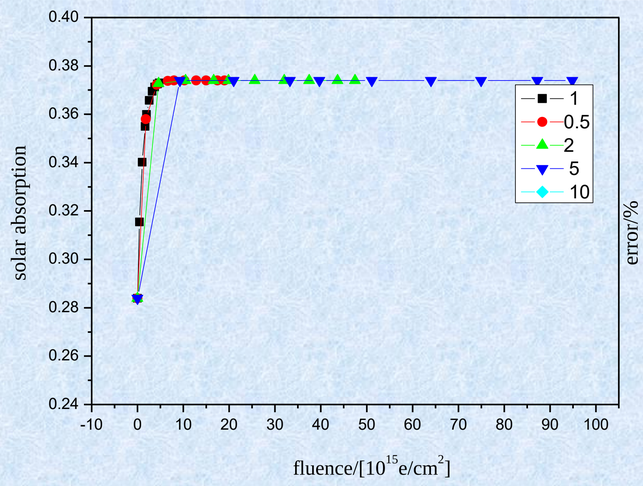
$$y = 0.374 - 0.0901\exp(-x/1.070)$$



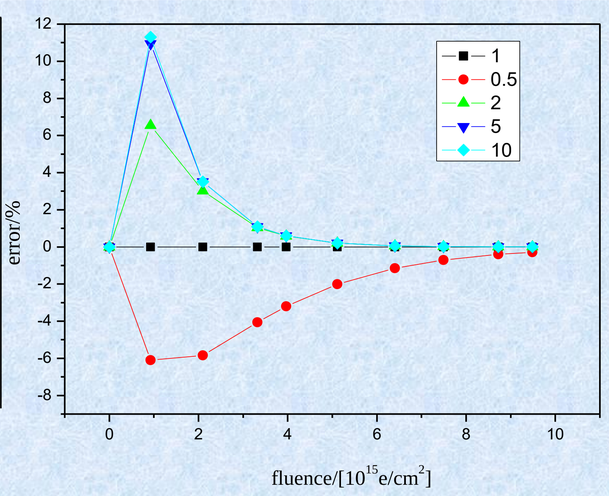
Solar absorptances of ITO/kapton/Al film in different proton fluencies

$$y = 1.811 + 1.793/[1 + \exp((x - 7.233)/1.281)]$$

INFLUENCE OF THE UNCERTAINTY OF ELECTRON RADIATION ENVIRONMENT MODEL ON THE SOLAR ABSORPTANCE EVALUATION OF ITO/KAPTON/AL FILM

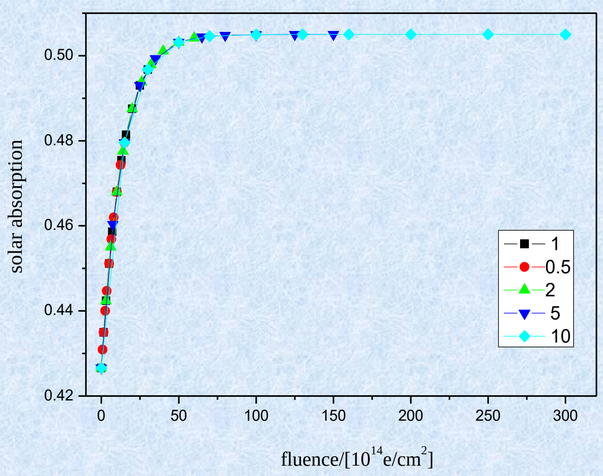


Solar absorptance variety of ITO/Kapton/Al under electron environment with different uncertainties

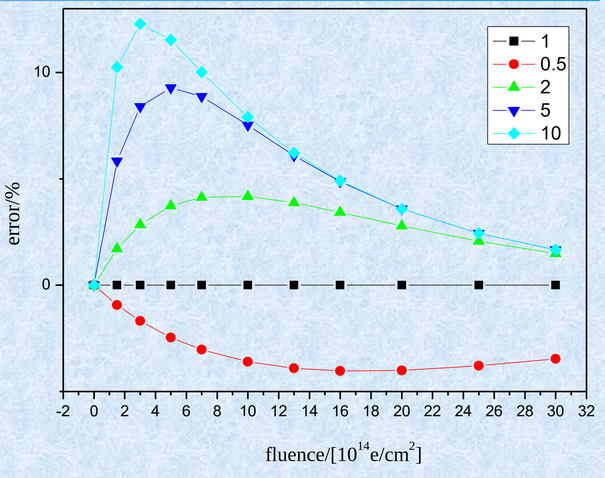


Comparison between errors from uncertainty of electron environment model

INFLUENCE OF THE UNCERTAINTY OF PROTON RADIATION ENVIRONMENT MODEL ON THE SOLAR ABSORPTANCE EVALUATION OF ITO/KAPTON/AL FILM



Solar absorptance variety of ITO/Kapton/Al under proton environment with different uncertainties



Comparison between errors from uncertainty of proton environment model

CONCLUSIONS

(1) The uncertainty of the space radiation environment model has a great influence on the solar absorptance of ITO/Kapton/Al film. With the increase of the radiation fluencies, the influence of the uncertainty on the solar absorptance of it decreases. When a certain fluency is reached, the influence of UF can be neglected.

(2) The influence of uncertainty on the solar absorptance of ITO/Kapton/Al film increases with the UF.

(3) When the UF is less than 1, the influence of the uncertainty of space radiation environment model on the solar absorptance of ITO/Kapton/Al film is negative. When the UF is larger than 1, it is positive.