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CURVATURE CONTROL OF MEMBRANE LAMINATED FILM STRUCTURE WITH SPUTTERING

Abstract

Thin film material is expected to be applied to space mission needing large area structure, especially, deployable large space structure because it enables to save weight of enlarged space structure and to be launched after stored into a small volume. An example is the use of thin film solar cells on solar power sail. However, there is a drawback that very thin film solar cells can curl without external force and it influences the whole sale shape. In this paper, design technique for curvature control of a thin film material is proposed. A thin film with high rigidity is formed on the surface of the thin film solar cell with a sputtering film deposition method, and the residual stress is conversely used as bending stress for the elimination of the curl. The deposition of zinc oxide that is a transparent conductive film and curium oxides that has ultraviolet absorption effect is conducted. Firstly, the residual stress was calculated by depositing on a sheet of glass and by measuring its deflection. Secondly, the curvature of a solar cell film on deposition was calculated by modeling multilayer structure of the thin film solar cell with the value of the residual stress. Finally, the deposition was actually conducted on the basis of the design value, and the result is compared with it in order to validate the design technique. As a result, although the shape was not as plane as designed, it is verified that the direction of curvature can be controlled. Furthermore, it is also verified that the change of curvature due to the change of solar cell film temperature can be reduced with the sputtering method by increasing the thickness of the deposition. In this paper, it is, therefore, revealed that the deposition with the sputtering method is effective in order to control the curvature of thin film solar cells.