

SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems Concepts (1)

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IKAROS - READY FOR LIFT-OFF AS THE WORLD'S FIRST SOLAR SAIL DEMONSTRATION IN
INTERPLANETARY SPACE

Abstract

Ikaros, the Interplanetary Kite-craft Accelerated by the Radiation Of the Sun, is a tiny technology demonstration spacecraft that will be launched in May of 2010 as a secondary payload with the PLANET-C spacecraft to the Venus. It aims at the world's first demonstration of the solar sail voyage in interplanetary field. Ikaros carries a 20m tip-to-tip square membrane sail made of polyimide including the thin film solar cells. The primary purpose of the mission is, first of all, the demonstration of deploying and expanding a large membrane sail taking the advantage of centrifugal force without use of any rib structure. And the mission also includes the first demonstration of the thin film solar cells with sophisticated radiation cooling strategy maintaining the solar cells temperature to keep the power output. Ikaros weighs about 300 kg and carries a cold gas reaction attitude control system. It completed the CDRs by this March and has finished the fabrication of the spacecraft bus system components by this summer. It is under the integration and testing phase waiting for the shipment to the launch site next March. The Ikaros has now unveiled its outline at the JAXA test facility. Ikaros is a spinner spacecraft and deploys a square sail by the associated centrifugal force. It can exclude the ribs and frames structure members and that contributes to the reduction of the spacecraft mass. However, at the cost of it, since the spacecraft carries enormous amount of angular momentum that must be orientated gradually along with the spacecraft revolution motion at the rate of one degrees per day, on average. How this attitude control capability is possessed is what the spacecraft design intensively devised. This paper presents several new technologies adopted for Ikaros. They are, 1) liquid crystal sheet steering device, 2) liquid-to-vapor equilibrium thruster with highly efficient heat exchanger, 3) thermal radiation enhancement technique adopted for the thin film solar cells, 4) a new attitude determination strategy using both sun sensor and RF sensor aboard as well as 5) a new polyimide film material capable of being adhered thermally. The paper will present how those items were developed and verified on the ground with some test data in figures, illustrations and some photos.