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EXPERIMENTAL APPROACH OF MOLECULAR CONTAMINATION FOR SOLAR-C EUVST'S CANDIDATE MATERIALS

Abstract

The SOLAR-C led by Japan in cooperation with foreign space agencies such as NASA and ESA is a next generation high-sensitivity solar ultraviolet spectroscopy satellite and equipped with the EUV High-throughput Spectroscopic Telescope (EUVST). It is planned to be launched with an Epsilon S rocket in 2028. The EUVST is extremely sensitive to molecular contaminant deposition resulting from its own organic materials outgassing in orbit such as carbon fiber reinforced plastics (CFRP), adhesives, etc. since the EUVST observes extreme ultraviolet and vacuum ultraviolet emitted from the sun. We analyzed the outgassing characteristics of the EUVST's candidate materials, CFRP and three types of epoxy adhesives in order to satisfy strict control requirements for molecular contamination.

The outgassing rate measurement facility consists of four Quartz Crystal Microbalances (QCM), effusion cell and LN_2-cooled shroud, based upon ASTM E 1559 method. The effusion cell included material samples, were heated at one °C per hour to measure the mass of contamination deposition onto the QCM in order to represent the temperature and time dependence of the outgassing mathematical model, i.e. diffusion equation of the molecules. Based on the results of outgassing rate measurement experiment, we constructed the outgassing mathematical models using the Japan's SPacecraft Induced Contamination Environment analytical software application Version 2 (J-SPICE2). The models were used to assess the bake-out effect of the CFRP and rank the three types of epoxy adhesives.

The results suggested that, assuming the CFRP was baked out up to twenty days, the total outgassing mass was three orders of magnitude less than doing nothing in 2.3 year mission period and the bake-

out effect was extremely high for highly volatile components. The results also suggested that there was a difference of up to six orders of magnitude numerically among three types of adhesives. These magnitude relations were consistent with the outgassing rate measurement experiment data. One of the three adhesives was significantly affected in terms of change in outgassing characteristics near the glass transition temperature.