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IN-FLIGHT RESEARCH OF CRYOCONDENSATION AND OUTGASSING OF THIN FILMS ON THE ELEMENTS OF INSTRUMENT DEEP-COOLED DETECTORS

Abstract

As a part of interplanetary vehicles designed to function in orbit or on the surface of the studied celestial bodies, optoelectronic devices with deep-cooled detectors are widely used. Under conditions of space vacuum, and even more so in a rarefied atmosphere of the studied celestial body, on the cryostatic surfaces (detector elements, protective windows, mirrors, lenses, special coatings), H2O, CO2, CH4 and other condensates can gradually form. Films with thicknesses of the order of 1 micron lead to noticeable changes in the reflective and absorbing properties of the surface, and, as a result, to a decrease in the sensitivity of the instrument. The elimination of films by outgassing may lead to many hours and even days of pause in the operation of the instrument, which is not always acceptable. The paper provides recent data on the growth rate of cryocondensates collected by the authors during a 6-year operation of the IKFS-2 infrared fourier-transform spectrometers aboard two Meteor-M spacecraft 2 and 2-2. The composition and dynamics of the film growth are considered. The phenomena accompanying the formation and removal of cryocondensate films are described. The results of calculations and promising contact and remote methods for the contamination mitigation and thin film removal are presented. The methods of removing the film without the need to stop the execution of planned instrument measurement program are considered.

Key words: cryocontamination, space-based interferometric measurements, cryodeposition, optical degradation, cryodeposit mitigation, fourier-spectrometer IKFS-2.