FINAL REPORT

Full Title:

Analysis of samples of reflector materials which are multicoated and metal samples with oxide coatings which have been exposed the space environment in LDEF testing.

Abbreviated Title:

Analysis of LDEF reflector and metal samples

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ABSTRACT

The use of low angle X-ray diffraction (XRD), X-ray photoelectron spectrometry (XPS) and Auger spectrometry have been tested as suitable methods for analysis of thin oxide films on metal substrates exposed to the space environment during LDEF testing. No significant changes in the composition of silicon monoxide overcoats on aluminum surfaces was found. XPS and Auger testing appear to be more suitable for ultrathin films than XRD.

EXPERIMENTAL METHODS

Sample:

The furnished test sample was a nickle metal disk coated with aluminum which was in turn overcoated with silicon monoxide.

Test Equipment

Low Angle X-Ray diffraction was accomplished using Siemens/Nicolet Mod. R3-MV and I-2 diffractometers. X-ray photoelectron and Auger spectra were obtained using a Kratos XSAM-800 system..

Results:

X-ray diffraction spectra clearly showed the characteristic peaks of Nickle and Aluminum. Very careful low angle diffraction studies showed peaks attributed to Silicon monoxide at a series of depths obtained by variation of the angle of incidence of the X-ray beam. The same results were more rapidly obtained using XPS

and Auger spectrometry but are only certain for a depth of ca 100 angstroms. the limit for XPS bean penetration

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No peaks indicative of silicon dioxide were found by either XRD, XPS or Auger spectrometry.

Conclusions:

Low Angle X-ray Diffraction is usable as a method for analyis of thin films on a metal substrate. However, X-ray Photoelectron Spectrometry and Auger Spectrometry are more rapid to use provided that data from only the very surface layer is required. XPS is limited to ca 100 angstroms depth. It thus appears that all of these methods have value for analyses of this type and all should be employed when possible.

No conversion of silicon monoxide, SiO, to silicon dioxide, SiO_2 , was observed by any analytical method used. From this, we concluded that, for exposure under these test conditions, SiO provides a stable overcoating material for aluminum mirrors.