JPL* ANALYTICAL CHEMISTRY LABORATORY** **P010-*updated
Analytical Chemistry and Materials Development Group 3531
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Subject: LIGO Mirror: Molecular Contamination Analysis

Purpose

Mirror surfaces were sampled using solvent wipes. This was to determine the level and identity of molecular contamination on the surface. The 2ITM04 and RM01 mirrors were analyzed.

Method

The analytical swabs consisted of dichloromethane (pre-tested) with specially extracted fiber free lens tissue. The areas sampled were 50 and 100 square centimeters. The low volatility residue (LVR) was analyzed using Diffuse Reflectance/ Fourier Transform Infrared (DRIFT/FTIR) spectroscopy. FTIR provides chemical functional group information for quantitative analysis and qualitative identification of materials. The analysis followed the ACL-120 procedure that complies with Mil-STD-1246C Notice 3 and is sensitive to the most stringent level (A/100).

Results

Only minor, trace levels of plasticizer (diallyl phthalate) were removed. The levels may be bounded to a monolayer thickness or less on the mirror surfaces.

Sample Location	Chemical Functional Group	Amount micro-grams/cm^2
2ITM04 Side AR edge 1	Trace Ester	< 0.01 (~~0.004 as diallyl Phthalate)
2ITM04 Side AR edge 2	Diallyl Phthalate	~0.01
2ITM04 AR Center	Diallyl Phthalate	~0.01
2ITM04 HR edge 1	Trace Ester	<0.01 (~~0.001 as diallyl Phthalate)
2ITM04 HR edge 2	Diallyl Phthalate	~0.02
2ITM04 HR Center	Trace Ester	< 0.01 (~~0.004 as diallyl Phthalate)
RM01 HR Center	Diallyl Phthalate	~0.02
RM01 HR Edge	Trace Ester	< 0.01 (~~0.005 as diallyl Phthalate)

Note: This is dially phthalate or a mixture of similar ester based plasticizers that are used in many plastics. A 1.0 microgram per square centimeter level is a 10-nanometer (nm) average film thickness for a residue with a density of 1.0. A rule of thumb is a monolayer is ~1 nm.

Discussion

The mirror surfaces were relatively clean in terms of molecular contamination. Approximately a monolayer level of contamination is typical for surfaces stored in a clean room. The optical attenuation effect of this level of contamination in the 1-micron wavelength region would be negligible.