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Test of First Contact™ Strippable material

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LIGO Science Collaboration

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Introduction

Mirror surface contamination can severely degrade the performance of the Advanced LIGO interferometers.

Particles are a primary source of contamination that generate scatter and greatly contribute to the increase of coating absorption. For this reason, the cleanliness of the mirrors must be carefully controlled throughout the entire interferometer's assembly process. We investigated the use of First Contact™, a strippable film, to protect and clean the mirror's surface.

1 The tests

Two tests were performed to evaluate possible residual contamination of the polymer film on the mirror's surface after stripping.

1.1 Test 1

Test one, done by Diffuse Reflectance/ Fourier Transform Infrared (DRIFT/FTIR) spectroscopy, was to determine if molecular residue remained after pealing off the film from a glass surface.

The test was performed at JPL's ANALYTICAL CHEMISTRY LABORATORY by Mark Anderson.

Glass test surfaces were pre-cleaned and tested to a level of less than 0.01 micrograms per square centimetre of molecular residue. The polymer solution was painted on to the clean glass and allowed to set for 2 hours. The material was then pealed off the surface. The surface was sampled using a dichloromethane swab/rinse. The low volatility residue (LVR) was analyzed using FTIR.

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).

The glass surface that was treated with First Contact™ (applied and removed) was found to be very clean with less than 0.02 micrograms per square centimetre of molecular residue.

1.2 Test 2

The other test was done to measure optical absorption on a mirror surface previously treated with the strippable material.

The optical absorption measurements were performed by Volodymyr Kondilenko and Ashot Markosyan at the Ginzton Labs, Stanford University.

The coating's optical absorption on 3" dia. mirror was measured at four points (Figure 1) using Photothermal Common-Path Interferometer (PCI).

The optical absorption results, in ppm, are shown on the bottom **"Before"** gray box.

Then, First Contact™ was poured on the mirror's surface and spread with a soft brush without touching the surface. The solution was allowed to cure for several hours under a laminar flow. The film was stripped and the part was sent back to Stanford for measurements.

1.3 Results

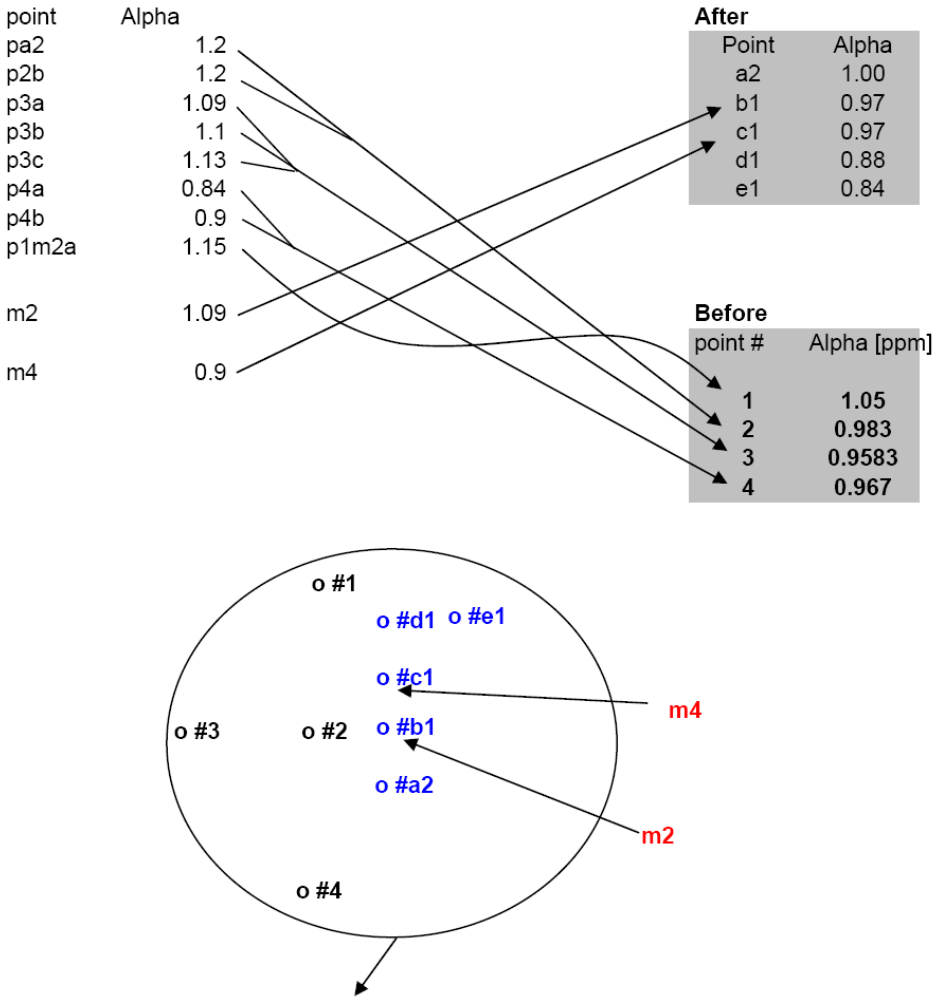

Figure 1

After the surface was treated with First Contact™, measurement points **#a2, #b1, #c1, #d1** and **#e1** were taken. (Figure 1)

The absorption measurement set-up was calibrated and measurements were taken at points pa2, p2b, p3a, p3b, p3c, 4pa, 4pb, p1m2a (not shown in **Figure 1)**, with measurement results indicated on the upper left table of **"Results";** the location of these points was as close as possible to the area of the ones measured **Before** surface treatment.

Measurements at points m2 and m4 were taken for the sole purpose of checking results before and after calibration.

2 Conclusions

We can conclude that after treatment of a surface with First Contact™

1. There was not detrimental molecular residue left on the treated surface
2. The absorption measurements before and after the surface treatment are within the instruments' error, hence, there was not increase in absorption.
3. The application of First Contact™, on a previously cleaned coated, surface is a suitable way to prevent contamination on mirror's surfaces throughout the assembly process of the Advanced LIGO interferometer.

Tests remain to be done on larger surfaces to assess if the film can be stripped without breaking.

LMA, in Lyon, will conduct independent tests on this material. Their results will be published at a later date.

As further information, there is a paper: "Test of Opticlean strip coating material for removing surface contamination" by Jean M. Bennett and Daniel Rönnow, published on APPLIED OPTICS, 1 June 2000/Vol. 39, No. 16 that states and demonstrates that "... no residue that produced scattering was found on a fresh silicon wafer when Opticlean was applied and then stripped off".

Since then, Opticlean changed its name to First Contact™.