Helena: Coating Status

SMA / VIRGO
- 2 thin; 2 thick substrates are getting coated with 30 alternate layers - 1/8 wave Ta2O5 and 3/8 wave of SiO2

MLD
- Received from MLD: Ta2O5 / Al2O3 coated substrates.

- On the following runs we are also coating 1" dia. samples to be evaluated for absorption:
In process: 2 thick, 2 thin "Q" substrates to be coated with 1/4 wave layers of Nb2O5/SiO2 for maximum reflectivity. There is a third thick substrate to be annealed with the coated samples as control. Measurements of the substrates wave front will be taken before and after annealing.

Scheduled runs:
Nb2O5/Al2O3 for 50 ppm transmission
Al2O3/SiO2 for 50 ppm transmission

Garilynn: Polishing Status

Goodrich Sapphire homogeneity
Homogeneity compensation at Goodrich is complete. Goodrich will be sending the 250mm sapphire piece to Caltech where the homogeneity will be verified. Goodrich has supplied before and after images of the homogeneity of this piece.
LIGO-C020137-02 contains four of these images, all are measurements made with circularly polarized light. The first two images represent the current state of the optic. One can clearly distinguish the orientation of the optic by the birefringence fringes running at 45 degrees, these are perpendicular to the wedge of the optic. Recall that the inhomogeneity of sapphire measures differently depending on the polarization with which it is probed.

1. Current compensated homogeneity, RMS 13 nm. They have chosen orientation "A" as the preferred orientation. There is a circular pattern, I don't know if this is incomplete subtraction of side one or just a residual on side two.
2. Current map of (what is believed to be) the other polarization. This is seen by aligning a different reflection. They apparently get three returns, one from the first surface, and two from the rear surface.
3. Orientation A before the last correction
4. As received from LIGO, which reflection was used is unknown.

It is certainly plausible that the two returns represent each polarization. Unfortunately these images are not clear because of the birefringence fringes running at 45°.

CSIRO homogeneity experiment
A draft report can be found at C020136-00; these results were reported last month, the document number is provided as a reference.

Gingin
The homogeneity data of one of the 150 mm sapphire pieces has been examined for beam sizes on the order r=10mm.
http://www.ligo.caltech.edu/~gari/Supporting/2cmSaphAhomog.JPG
shows an image of the homogeneity (over r=10mm) of one of the 150 mm diameter pieces that we have been considering using for Gingin.

The image of the whole piece can be seen at
http://www.ligo.caltech.edu/~gari/LIGOII/homogeneity.htm
by choosing Saphah9a (the third data set.)
For the analysis above, I chose an area in the blue streak just down from center (there are masked pixels in the center of the data set due to an internal reflection in the interferometer)

If I choose r=10mm area just to the right of center it is even better, ~2.7nm rms.

Crystal Systems
CSI reports a successful growth of a 15" boule. They say it looks good. This is the third attempt at the new size.

Roger: Optical Absorption

Here are our just-completed measurements on the Ta2O5/Al2O3 films. The loss values shown are average values from a point-by-point line scan across the diameter of each sample. We excluded any localized bumps from the averaging procedure so the numbers can be thought of as baseline values.

Several things to note:

1. There is more jitter in these measurements from sample to sample than in the previous three sets. There are several possibilities that come to mind and we will probably do repeat scans on a couple of specimens to verify our results. Also, in thinking about these results, we should fold in any differences in the number of layer pairs comprising these specimens than were present in the earlier three sets.

2. Loss in the Ta2O5/Al2O3 set seems to be flattening out with increases in annealing temperature as opposed to the behavior of the /SiO2 specimens where the trend suggests that higher annealing temperatures will be of benefit.

3. Marty points out that the Nb2O5/SiO2 and the Ta2O5/SiO2 coated specimens annealed at the same temperatures sit right on top of each other. This could suggest that the SiO2 layer is controlling and that the Ta2O5 and the Nb2O5 layers are not contributing significantly.

Mechanical Loss:

Gregg

We have been finishing up Q measurements on the silica/tantala coated samples. We measured the drumhead mode of sample 3, which is coated with 30 layers of silica/tantala in even proportion. The Q was 424,000. We also measured the drumhead mode of sample 4, coated with 2 layers of silica/tantala in even proportion. The Q was 6.4 million. These values give coating phi's of 1.7 10^-4 for sample 3 and 1.9 10^-4 for sample 4, which are a little high compared to other modes. We are continuing to make measurements on sample 4.

We have finished the FEA modeling and calculation of the energy in the coating for all measured modes. For both the butterfly modes and the drumhead, the ratio of energy in the coating to the substrate increased by 5 percent from the values presented at the LSC meeting. This means the predicted coating phi dropped
to around 1.5 10^-4 from 1.7 10^-4 presented at LSC.

Using the final values from the FEA we find phi values for silica and tantala; phisio2 = -0.26 +/- 0.43 10^-4, phi ta2o5 = 2.3 +/- 0.15 10^-4.

We are in possession of a 30 layer alumina/tantala sample coated at MLD in Oregon. It will be the next sample we measure.

Sheila:

Since LSC, experimental measurements focused on investigation of any time dependence of Q of coated samples. Preliminary results suggest may see some degradation of Q with time - still under investigation.

Two Al2O3/Ta2O5 coated silica samples from MLD next in line to be measured as part of the main coating loss program.

After discussions at LSC, calculations of ("standard") thermo-elastic damping in thin flexing samples of sapphire revisited re: using thin coating samples
- still looks to be at a significant level.

David Blair: High Optical Power Test Facility Project Summary (Perth)

Status report: **note that there are two issues where we need feedback.**

Injection optics for high power interferometer being designed.

Heating ring and FEM thermal model being investigated for test masses. We intend to investigate the thermal compensation transfer function (esp the thermal time constant for compensation) unless this has already been done by MIT.Request feedback from LIGO.

Prototype 4kg sapphire test mass in Australia but not delivered to UWA yet (Q and optical measurements prior to polishing and coating) We hope to slot this into the polishing and coating runs for the LIGO HOPTF masses. Request feedback from LIGO

HOPTF test masses: final design including capability for fused silica or niobium flexure suspensions (flats and slots) almost finalised awaiting confirmation from LIGO.

First test mass cradle and electrostatic control plate due to be finished this week.

Isolators and Suspensions on track for first tests Oct-Dec 2002.Vertical antispring frequency reduction experiments planned in next month in parallel with first tests of 3 stage isolator.

Locking and control systems: two optical cavities locked up preparatory to installation at Gingin.