Minutes of the Core Optics Subgroup, 2/14/02

9 am PST US/Europe meeting

UF: David R.
CIT: GariLynn, Helena, Gary, Ricardo
MIT: Gregg, David S., Peter F.
Glasgow: Jim, Sheila, Peter S.
Stanford: Roger, Sheila, Vlad, Norna,

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1) Coating Status (Helena)

- Some questions have arisen about the processing (high temperature baking) of some of the optics that were coated for Q testing at MIT. Helena is following up with Jean Marie Mackowski (JMM).

- JMM reports that they have seen that the coating characteristics depend on the initial conditions (polishing) of the substrate. They notice changes in coating absorption; not yet sure if mechanical Q is affected in any way.

- MLD is currently working on a Ta_2O_5 / Al_2O_3 coating run.

- CIT has developed a prototype ergonomic arm for lifting large optics.

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2) Polishing Status (Gari)

- Goodrich has finished the compensating polish on the 25 cm sapphire substrate. They achieved a wavefront of ~ 14 nm RMS measured in single pass. This exceeds the required specification of 20 nm, but doesn't meet the goal of 10 nm. They claim that the process is repeatable and controllable. Data is being sent to CIT.

- CSIRO has finished their feasibilities studies of different spot polishing methods for sapphire. Of the three methods, ion beam etching works the best. They demonstrated a 1 cm profile and can get to 5 mm. Compensating polishing also worked well. Fluid polishing gave too low a material removal rate to be useful.

- Peter and GariLynn visited Crystal Systems (CSI) last month. CSI produced a 15 inch diameter boule (orientation?), but it will be difficult to core out substrates with the desired AdL thickness. CSI is asking LIGO to think about changing the aspect ratio of the substrates…

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3) Sapphire Absorption (Roger)

- The final chapter in the continuing saga of the Stanford 1600 deg. furnace: After numerous problems over the past few months, the furnace is finally operational.

- the 1400 deg. furnace is baking some of the CSI windows for comparative absorption studies. Some discussion is taking place with CSI concerning confusing data about surface aborption caused by different surface preparation results. Nevertheless, Stanford reports a 10 ppm reduction in the center of the windows (from 65 to 55 ppm) after baking for 200 hrs. Some questions arose about the feasibility of doing large components; as of now, Stanford is limited by the diameter of the alumina tube in the oven. It should be possible to do 3" x 1" pieces with minimal modifications, though. Also, at 1400, no evidence of surface deformation is seen. This will be checked again at 1600 deg.

- Vlad is working on fused silica and Nb_2O_5 / SiO_2 coatings. He is still working on getting a good calibration for fused silica. Also, sees anomalously large absorption in the Nb coatings, 40-60 ppm. Helena is going to send a tantalum coated piece (4 ppm absorption) for comparison.

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4) Q measurements (Sheila, Gregg)

- Glasgow has measured a the Q of a number of different fused silica coated Ta_2O_5 / SiO_2 samples:
    - annealed substrates
    - 2 layer sample: $\lambda/4$ Ta_2O_5 , $\lambda/4$ SiO_2
    - 30 layer sample: $\lambda/4$ Ta_2O_5 , $\lambda/4$ SiO_2
    - 30 layer sample: $\lambda/8$ Ta_2O_5 , $\lambda/8$ SiO_2

5 modes measured in all samples; measurements also made before coating. The data analysis subtracts the intrinsic loss, however, the annealing changes the intrinsic loss, so some care must be taken to properly extract the coating loss. The observations:

- annealing increases the Q of the C4 (butterfly) mode of the optics, but reduces (roughly equally?) the Q of the fundamental mode. In order to unfold this, details about how the annealing was done are needed. In particular, how was the optic held during heating?
- The 30 layer piece had a loss of $2.5(+/- 0.4) \times 10^{-4}$, larger then the 2 layer piece (??).
- The 60 layer piece showed a loss of $3.0(+/- 0.3) \times 10^{-4}$, roughly equivalent to the 30 layer case.

- A coated sapphire mass has also been measured (this mass had coating spilling over to the barrel). Again, 5 modes were measured before and after coating. A (large) coating loss of 9×10^{-4} was measured. Again, anomalous behavior in the different modes is seen.

- MIT and Syracuse have measured 2 layer and 30 layer samples. They find similar behavior as reported by Glasgow, but some strange behavior is also seen. MIT and Syracuse see large differences in the butterfly modes. Some discussion of the effects of annealing on the welds that are used to support the sample took place. MIT also looked at a 30 layer sample of $3\lambda/4$ Ta_2O_5 / $\lambda/4$ SiO_2. They see a slight drop in Q as compared with the matched layer sample, indicating that the Ta layer may be more lossy.

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5) Wrap up, upcoming deadlines

- None, per se.

5:30 pm PST Telecon

UF: Davd
UWA: David B., Ju Li
Gingin: Zhou, Yonglan
Adelaide: Peter V.

- UWA: A report on Gingin: preliminary results on test mass suspension controllers have been achieved. Using electrostatic comb capacitors as actuators, tests on the angular DOFs were performed using Labview-based software.

- Adelaide: The optical configuration for the Gingin High Power Facility has been specified. A meeting of the Gingin Advisory Committee (scheduled for next week) will go over the plans. Thermal loading calculations using Melody have been performed on the proposed configuration to examine thermal loading issues. A Hartmann wavefront sensor is under development for in situ measurement of thermal distortions.