

Minutes of the Core Optics Subgroup, 1/10/02

9 am PST US/Europe meeting

UF: David R.

CIT: Norna, GariLynn, Helena

MIT: Gregg, David S., Peter F.

Glasgow: Jim, Sheila, Peter S.

Stanford: Roger, Marty, Vlad

1) Coating Status

- Gary S., Helena and Gregg visited MLD in early January. Since the last visit (~ 1 year ago), MLD has made many improvements to their capability. In particular, they are setting up a characterization lab to look at coating parameters. MLD is willing to work with LIGO on absorption and also Q studies if needed. Gregg noted that one interesting technology they employ eliminates the sharp boundary between coating layers such that they can control how much blending (gradients) occurs between coating layers. We'll start them with a classic 30 layer coating to compare Q results between the different vendors.

- Achieving AdL goals for low absorption in the coatings is appearing more feasible. Mackowski (JMM) reports 0.2ppm coating absorption (AdL target is 0.1 ppm).

- We have just received 30 layer $\lambda/4$ wave Ta₂O₅ and SiO₂ parts from SMA-Virgo: 2 thin (for MIT) and 2 thick (for Glasgow/Stanford). We have 4 more of each type at SMA for 30 layer $3\lambda/8$ and $\lambda/8$ Ta₂O₅ and SiO₂ coatings to look at material thickness dependence. Following that is a 60 layer run of $\lambda/8$ Ta₂O₅ and SiO₂. After these are in process, it was agreed that we should send MLD and REO substrates for 30 layer coatings to see if there is a difference between vendors. Two suprasil substrates are ready for coating.

- LIGO is in the process of ordering 10 more of each type of substrate. Substrates are the limiting resource right now, so we have to plan our coating runs carefully.

- Some discussion of altering the ordering and nature of the Q runs was discussed. One possibility suggested was to use Aluminum Oxide instead of SiO₂ as the low index material. Dave R. advocates waiting until we have results for this first run before we change the plan.

- Jim requested a small delay in shipping substrates to SMA-Virgo to complete characterization. It was agreed to delay the next shipment of substrates from Glasgow to Lyon until the 18 Feb. We will re-examine the coating plan at the next LSC

- Helena reports that MLD is trying Nb with different anneal temperatures for absorption studies; will await absorption results.

- CIT is working on the ergonomic arm for lifting large optics. We have decided to adopt the vacuum cap for lifting because the process is less sensitive to tooling tolerance. This work is being done with the CIT machine shop.

2) Polishing Status (Gari)

- Goodrich notes that they see two different patterns in the substrate homogeneity depending on polarization. This was known and documented in the CSIRO report on such measurements, and Goodrich has a copy of this report but apparently forgot. The homogeneity depends on which polarization the bulk is probed with. Unfortunately, Goodrich has not been careful about using only one polarization and been compensating for one then the other. CIT informed them of the problem and it has been corrected. As of now either polarization will work for testing purposes, however, the IFO design may specify a particular polarization.

3) Sapphire Absorption (Roger)

- The absorption measurement system is now reproducible and reliable. Vlad is working through measuring 36 1/2 windows which will then go to CSI for annealing, hopefully by 1/11. They will then work on standards for fused silica absorption.

- The CIT furnace has arrived at Stanford, with some damage due to shipping. We are working with the vendor to determine if Stanford should fix it or get new one with 4 week delivery. Consensus to have a new unit shipped out.

- The first set of measurements on sapphire before and after heat treating showed a reduction from 65ppm/cm to 55ppm/cm in the bulk.

- The 10W laser provides sufficient resolution measuring sapphire and shouldn't have a problem measuring FS. We will get to work on the samples from MLD beginning 1/14

4) Q measurements (Gregg, Sheila)

Sheila reports working on characterizing blanks for the coating experiments followed by measurements of the coated samples that came back from JMM.

Post-telecon news: The first of the samples coated at SMA-Virgo have been characterized; Peter Snelling at Glasgow has preliminary results for both the 30 layer and 2 layer SiO₂/ Ta₂O₅ coated samples. The results suggest that the loss in the coating in the 30 layer sample is slightly greater than 2×10^{-4} , although more work is needed to be precise about the number. (This is close to both the Syracuse coated silica numbers and the Stanford/Glasgow coated sapphire numbers both of which were for the same coating materials). The 2 layer coating has had a much smaller effect on the measured Q's of the modes of the silica sample, basically at the resolution limit of the initial measurements.

MIT results on the thin sample with the 30 layer coating that are in good agreement with the Glasgow results, in the range of 1 to 4 x 10⁻⁴ for the coating loss. MIT is performing more measurements and modeling to better determine the energy distribution in the sample.

This suggests that the loss is not associated with the first interface of the coating with the substrate material, but instead is related to the body of the coating (i.e. material or multiplayer interfaces).

5) Wrap up, upcoming deadlines

- Peter F. and Gari requested inputs for their visit to CSI taking place the week of 1/15.
- The Glasgow group is getting a 25 X 12 a-axis piece of sapphire (polished in the UK) for bonding and suspension trials. The current plan is to demonstrate hanging from a heavy glass mass, looking for stresses, response to temperature change, Q. We would like to have it at Christmas next year for the hanging test. **This piece may be available for other testing.**

GariLynn B noted that Glasgow could use the large piece of sapphire (currently at Goodrich) for their testing, with Glasgow buying a piece that has more general testing value for the AdL effort.

5:30 pm PST Telecon

CIT: Gari

UWA: David B.,

Adelaide: Peter V., Jesper M.

- David Blair notes the difference between theory and measurement of Rayleigh scattering, a factor of 1/2 in Sapphire where the theoretical value was 20ppm and the measured value was 10ppm. Fused Silica theory yields a few ppm, the measured value is 10ppm. For further info see: Setah Benabit thesis at UWA

- UWA is now getting vacuum system and suspensions in place. We are also getting preliminary optical cavities going in order to get instrumentation in place for the high power experiments.

- Peter V. presented a strawman design and set of experiments for the Gingin High Power test facility. ACIGA wants to present the Gingin plan at next LSC