

Minutes of the Core Optics Subgroup, 2/15/01

CIT: Helena, Gari, Jordan

MIT: Ryan, Peter

Glasgow: Jim

Stanford: Sheila, Roger, Alex, Marty

UF: Dave

9 am PST US/Europe meeting

Announcements: Jordan pointed out the results presented at Aspen about the effect of coating on Q and thermal noise. Based on current measurements, the range of Advanced LIGO will be reduced by ~ 20%. He advocates an R&D program geared at exploring these effects.

1) Coating Status (Helena)

Nothing much new to report. Barry and Gary will follow up with the VIRGO folks in Europe regarding the Lyon facility; they will know more in about two weeks. Dave R. is going to visit JM Mackowski in two weeks.

2) Sapphire polishing (Gari)

CSIRO has been able to get faster results using diamond slurry on Teflon. They will next try diamond slurry on pitch, which would be the ideal way to do pre-figuring on Sapphire. GO will start their small sample when the 40 Meter order goes in. They have already put a (rms= \sim 3nm) polish on the large sapphire sample that we have. The Spec and Drawing for polishing of the Large Sapphire piece were completed in January - Peter F. has OK'd them, we're waiting for a signature from Dennis C. before we go to Raytheon (HDOS) for quote.

CSIRO would like to have a couple of small sapphire samples to use for testing processes, GB asked if there were any available. There were no volunteers.

3) Sapphire Absorption (Alex)

Crystal Systems is studying different annealing processes, such as longer time, higher temp, lower O₂ pressure, and two-stage temperature annealing.

A recent attempt at a temperature step down anneal gave much worse results. Tried a 2 stage anneal in attempt to address a scattering problem. This sample showed unusually high bulk (surface) absorption of 550 (1000) ppm at IR wavelengths. This is an order of magnitude higher than normal, but scatter went down significantly. Jordan suggested the possibility of contaminants in the oven. Marty suggested that Steve McGuire be brought into the loop to correlate the optical data against neutron scattering results.

Stanford received some of the High Purity samples from CSI #7 and #8. #8 had 100 ppm absorption, but the top part of crystal showed a sharp boundary of absorption transitioning from 100 to 20 ppm of absorption. This is the raw result before annealing. They intend to go back and review samples from the beginning. They are still waiting for samples 9, 11 and 13.

4) Q measurements on coated and uncoated sapphire and fused silica (Sheila)

Ongoing controlled studies of coated and uncoated fused silica and sapphire at Glasgow and Stanford:

- Sapphire (m-axis sample coated at REO) - coating loss of 4×10^{-4}

- Fused silica sample - coating loss 1.7×10^{-4} ; Syracuse folks are also measuring these; their measurement of coating loss on FS is 3×10^{-4} . The Stanford numbers imply an increase in thermal noise of 1.4 due to coatings.

AR coating has less of an effect on Q.

As noted above, a thermal noise analysis impacts Advanced LIGO sensitivity.

5) Sapphire thermophysical properties (Jordan)

Ryan reported on recent results using a Shack Hartmann to measure thermally-induced optical path differences in a SIOM sapphire piece upon pumping with a CO2 laser. This technique does not directly give the thermal expansion coeff. α , but couples α and dn/dT . Assuming literature values for dn/dT , he gets a value for the thermal expansion coeff. $\alpha = 3.5 \times 10^{-6}/K$. Jordan pointed out that this is much lower than literature values or outside measurements in conjunction with CIT. Since this piece was produced by SIOM (and is the only SIOM piece measured to date for TP properties, this could be an effect of growth process. Jordan will get Ryan some new samples. Marty suggested that one could cleanly separate the thermal expansion from the dn/dT contributions by looking at transient birefringence effects.

6) Announcements - Summary of NSF Review (Jordan)

Minutes of the 4:30 pm telecon with UWA are not available