Core Optics Telecon, Dec 14, 2000, 9 am PST

Participants: Jordan C., Helena A., Gari B., Bill K., Gary S. (CIT)
Mike Z., David S. (MIT)
Sheila R., Roger R., Alex A.(Stanford)
Jim H., Norna R. (Glasgow)
Dave R. (LLO)

Sapphire Coating – Helena

Helena has contacted several coating companies about coating AdL sapphire core optics.

REO: wants to establish a dedicated coating facility for AdL optics

Virgo Coating Facility (Lyon, France): – Helena visited the facility and came away with a positive impression. No track record on (really) large optics to date, but they have chambers for handling large optics. No planetary rotator but coating uniformity to date is good. Good in-house diagnostics for characterizing coatings. (Jim reported having problems in coatings for GEO mirrors in first generation coating chambers, but the chambers have since been modified so should be OK.) Claim they can do 6 mirrors/month at full production capability. Meeting on Sunday with facility head JM Makowsky at CIT went well. Gary and David will do a follow up visit in early January.

CSIRO: no track record on large optics, but good in-house diagnostics. Have done 15 cm diameter blanks for LIGO. Facility head Roger Netherfield is experienced.

MLD: still waiting for response to RFP.

Laser Zentrum: no response; consensus is to drop them.

Central Research Lab (Japan): did TAMA optics, but can't handle large optics.

Zeiss – very expensive and excessive birefringence seen in earlier coatings; probably forget about them.

Sapphire Polishing Effort – Gari

Some discussion of requirements; can polishers eliminate Zernicke aberrations?? Also, the CIT phase mapping interferometer can do 150 mm apertures with sufficient spatial resolution; do we need larger aperture characterization for AdL? FFT codes might provide an answer. This is an action item.

- CSIRO: efforts are underway; can apply in-house metrology in between polishing stages for subsequent stage correction and compensating internal material inhomogeneities.

- Hughes-Danbury: computer-controlled processing, can control spatial frequencies on mm scales, also can do feedback metrology. Earlier hard feelings about losing LIGO I contract seem to have faded.

- General Optics: less expensive than compared with CSIRO and H-D; no in-house metrology, though.

Sapphire Absorption – Alex

Working with Crystal Systems. Normal CS 10 mm diameter samples have 50-60 ppm/cm bulk absorption; high temperature anneal in air/oxygen for reduces absorption to 25-30 ppm. (25 ppm/cm is the crossover point in thermal lensing performance between sapphire and fused silica.) Absorption homogeneity is good, although there is some residual higher surface absorption; at lower temperatures., absorption reduction is only seen in a few mm into the sample. Still exploring the parameter space of [temp, oxygen partial pressure time, time], but presumably diffusion is the relevant physics, so higher temperatures and longer times should allow this process to work on larger optics.

Some discussion of photothermal deflection measurements of novel Corning fused silica samples. Problem is the lack of a good (in this case high absorbing) characterized reference sample to calibrate the PTD apparatus.

Thermophysical constants – Jordan

Measurements of relevant thermophysical constants (thermal conductivity, thermal expansion coefficient, dn/dT,….) are underway by Precision Measurement Instrument Corp. Their values come in at the high end of the literature values. Mike suggested that since they use interferometry for measuring thermal expansion, they could get dn/dT using a reference.

Ryan Lawrence at MIT is looking at c-axis and m-axis materials heated by a CO2 laser. Measurements are ongoing…

Sapphire Q's – Sheila

Looking at 8 cm x 3 cm rods before and after coating; measuring 5 modes. Coating reduces Q's by ~ 2-3X (examples: one higher mode gave 5 x 10^7 before coating and 1.6 x 10^7 after coating). Measurements are improving as they get a better handle on minimizing the effect of suspensions.

Upcoming Deadlines – Gary

NSF Panel Review of LIGO R&D proposal in late January; people who need to attend have been notified.

Core Optics Telecon, Dec 14, 2000, 4:30 pm PST

Participants: David B., J. Li, Fetah B., John W., Darren
Helena A., Gari B. (CIT)
Dave R. (LLO)

Sapphire Coating – Helena summarized efforts underway for the UWA folks.

Sapphire Polishing – Gari summarized efforts underway for the UWA folks.

UWA effort – David Blair and Fetah B.

David summarized on-going efforts at UWA and AIGO. Funding has been obtained for establishing a high power test facility at AIGO. The plan is to set up a linear coupled cavity (a recycling mirror and a Fabry Perot arm; possibly a beam splitter) mimicking AdL powers using 16 cm dia. sapphire mirrors for the FP mirrors. Current schedule:

2002 - vacuum system operational
install 5 W Adelaide laser
seismic isolation first article installed
final design for test mass suspensions (Nb flexure)
measure pendulum modes and internal Q's (fused silica TMs??)
shake down controls

2003 – install 100 W Adelaide laser
install sapphire core optics**
begin cavity locking and stability investigations

**LIGO to provide coated sapphire mirrors; David requested that LIGO verify a time table for getting optics to UWA.

Fetah - summarized earlier scattering, absorption, and birefringence measurements on c-axis SIOM (China) sapphire pieces. First pieces from SIOM has anomalously large scattering loss (230 ppm/cm; interior bubbles visible by the unaided eye). Absorption losses similar to those measured at Stanford; 25 ppm/cm seen after annealing. 0.02 deg/cm birefringence measured.

New sapphire pieces from SIOM arrived at UWA last week; supposedly of higher quality. They will be looked at over the coming weeks.

David reminded everyone to come to Perth for the Amaldi Conference in July 2001 and suggested setting up a core optics work shop at the meeting.