L.8: Development of specialized optical coatings at RRCAT

Optical components with specialized optical coatings are important for our laser program. Some of these coatings are also important for IR beam line in Indus-I. These components are expensive and not available indigenously. Optical coating facility at RRCAT has ion-assisted dual e-beam, sputter deposition systems and characterization instruments. Some of the specialized coatings developed are described below.

Development of tunable fabry-perot filter

Tunable fabry-perot filter was developed by incorporating a computer controlled precise linear motion of a shutter at various speeds (200 μm/sec to 1mm/sec) inside the coating plant for the deposition of graded thickness spacer layer. The spacer layer thickness was varied from 125 to 160 nm across a 25 mm dia. substrate. 9 channels each of FWHM = 3 nm can be placed each 2 mm apart from the previous channel on the substrate.

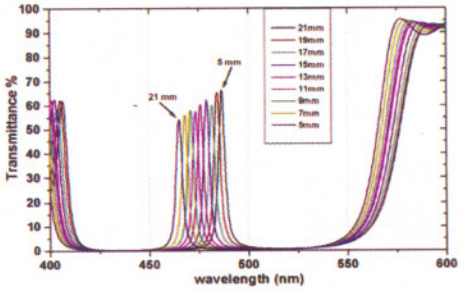


Fig. L.8.1. Trans. spectra of tunable fabry-perot.

Development of AR coating for p-polarised light on prisms for CVL pumped dye lasers.

CVL pumped dye laser cavities use prism-grating-HR mirror combination for achieving narrow bandwidth. Prisms in such cavities are used at large angle of incidence > 80° for obtaining large beam expansion resulting in high reflection loss (> 23% for p-polarised light). Multilayer AR coating was designed for p-polarised light at 88°, 83.2° and 81° AOI and deposited on EDF and BK7 prisms respectively. Reflection loss got reduced from 74 to 10% for 88° AOI, 38% to 0.8% for 83.2° AOI and 27.4% to 0.1% for 81° AOI. These coatings helped in obtaining lasing in dye laser cavity.

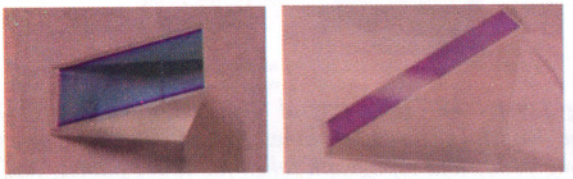
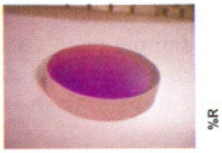


Fig. L.8.2. AR coated prisms for dye lasers.

Development of coatings for air spaced and solid etalon

Development of narrow line-width tunable dye laser activity at RRCAT requires etalons. Therefore indigenous development of air spaced and solid etalons were taken up. 90% reflecting coating was required to get optimum output from the etalon. For this an eight layer dielectric coating was designed. Coatings were made on 50 mm dia., 10mm thick fused silica optical flats (~/50) fabricated in our Optical Workshop. Special precaution was taken so that surface figure can be maintained even after completing the entire coating process. Finesse measurement was carried out at Optical Workshop, RRCAT and finesse of ≈ 24 and ≈ 26 @ 632.8 nm, for air spaced and solid etalon were achieved respectively. Reflectivity limited finesse of this multilayered coating is ~28.



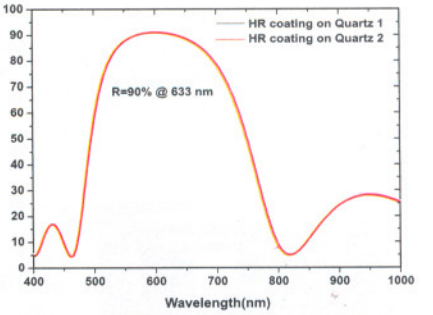
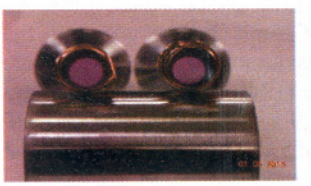


Fig. L.8.3 Refl. of HR coating on quartz etalon.

AR Coating on both sides of Nd:YAG laser rods

Imported Nd:YAG laser rods has AR coating on its end faces. These coatings get damaged during rigorous use. Such rods of 10mm x 100mm and 10mm x 150mm were polished at our Optical Workshop and subsequently vacuum AR coating was done. Special rod holder was made. Deposition was carried out at 125°C under Ar ion assisted environment to grow dense MgF_2 film. Reflectivity of the coating was and was < 0.2%. Coating did not develop any damage and delivered 1500mJ in <10 ns pulse @ 2Hz. Similarlly AR coated 150mm long Nd:YAG laser rods yield 300J pulse energy (2 – 40msec, 1 – 100Hz rep. rate, 10Kw peak power). AR Coatings withstood such pulse energies.



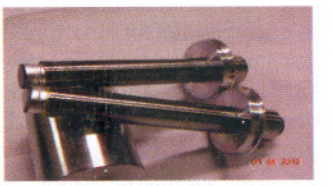


Fig. L.8.4. AR coated Nd:YAG laser rods

Cr/Au coating for IR beamline of Indus-1

Coatings (Cr/Au) were made on optically polished S.S. substrates (75mm dia.) for IR beam line of Indus-I. Cr layer improves the adhesion of Au layer on SS. Coating was tested against moderate abrasion. Measured reflectivity of coated mirrors were ~ 96% @633nm.

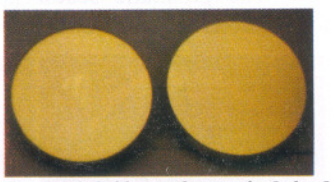


Fig. L.8.5 Gold coated optics for Indus-I.

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