Fig. L.8.1 View of the deposition system.

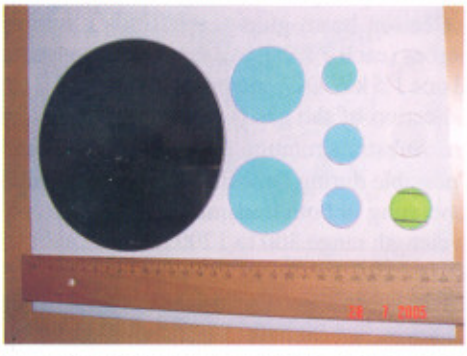

Fig. L.8.2 View of some of the coatings made.

Coatings were done are: (i) AR coatings on lenses used for coupling a Nd:YAG laser into optical fibre, (ii) Specialized AR coatings on the end faces of Nd:YAG laser rods. These coatings were found to be hard and withstood laser fluence of 1.2 GW/cm^2, (iii) Gold coating on Si wafer with rms roughness less than 1nm for Indus-1 beam line, (iv) Very thick gold coating on Al foils of different thickness to be used as targets for laser produced plasma experiments, (v) Aluminium coating on 100mm dia. glass samples for Spectroscopy Div., BARC, (vi) Thick Ti coating on 240 mm diameter copper disc is being developed for IGCAR. Fig. L.8.2 shows the view of a few coated elements.

(Contributed by: C. Mukherjee; cmukh@cat.ernet.in)

L.9 Advancement in sealed-off nitrogen laser system and uranium analyzer

A compact sealed-off nitrogen laser module with a life of more than a year has been developed, which is suitable for field applications. A setup for laser tube assembly and processing facility has been established for vacuum processing the metal-ceramic laser tube before filling and sealing. The laser tube is connected to the vacuum system via a glass-to-metal seal. A double stage liquid-nitrogen trap is incorporated between the vacuum system and the laser tube. This ensures that the volatile impurities such as water vapor and carbon dioxide can be trapped from the filling nitrogen gas, which is detrimental to the laser tube lifetime. The tubes are baked till all out-gassing ceases and then filled with Iolar (grade-I) nitrogen gas. They are run for a sufficient time till the output power stabilizes, then refilled with fresh gas and sealed. Such laser tubes are operated at an underrated voltage of 6 kV for reliability, and produce 30μJ pulses at 10 Hz repetition rate. The Nitrogen laser module has a size of 145 x 75 x 50 mm, works on 12V DC and is an important import substitute.

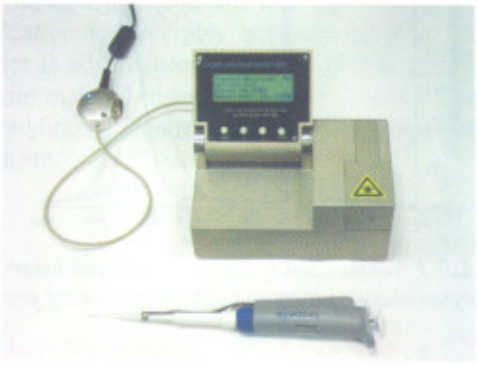

Fig. L.9.1 The compact version of the Laser Uranium Analyzer

An ultra compact version of laser uranium analyzer has also been developed using the above mentioned compact nitrogen laser tube (fig. L.9.1). Its detection sensitivity ranges from 0.01ppb to 20ppb and requires only 6 W power. It uses a miniature spark gap operating on 12V, SMD based electronics for data acquisition and processing, a compact detector module with a miniature PMT and power supply using SMD components. This is an important import substitute. Three such systems have been assembled and are undergoing test and calibration. Twenty systems are being engineered for various users in DAE, for use in uranium mining, radio chemistry, effluent monitoring & health physics applications.

(Contributed by: A.G. Bhujle; bhujle@cat.ernet.in, S. Raja, Shyamsundar, V. Bhange, V.P. Deshpande, C. Rajan)

L.10 Compact density measurement station

Compact density measurement station has been developed for the metrology of sintered uranium oxide fuel pellets for Nuclear Fuel Complex (NFC) (fig.L10.1). This is designed around a multiplexed optical system to reduce the electronic complexity. A single scanner is used to generate the scans using a multiplexing prism as well as electronics implemented in CPLD to make the instrument compact and reliable.

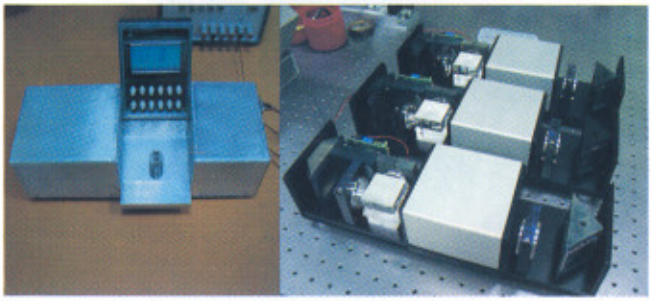

Fig. L.10.1 The new version of the density measurement station

The optical scanning is achieved using a polygon mounted on a brush less dc motor, which scans the laser beam, and a collimating lens generates the line scan. The duration for which the pellet obstructs the laser gives a measure of its size. The diameter and length of the pellet placed in the collimated scan region are simultaneously measured and are used to calculate the geometric volume of the fuel pellet. The weight of the pellet is acquired from a weighing machine interfaced to the system. The sintered density of fuel pellets is needed before they are taken up for assembly into fuel bundles. Three such systems have been developed for NFC, Hyderabad.

(Contributed by: A.G. Bhujle; bhujle@cat.ernet.in, S. Raja, K. Aneesh)

L.11 Digital speckle metrology

When a coherent wave is reflected from or transmitted through an optically rough surface it forms what is called a speckle pattern. It arises from the self-interference of waves generated by diffuse objects. The speckle patterns are recorded using high-resolution CCD cameras, are electronically stored and correlated numerically. Shearing Speckle Interferometry is a laser based, optical, non-contact and non-destructive method widely used for the stress and strain analysis of loaded structures and for non-destructive testing. It is an optical method based on the principle of speckle correlation where interferometer is used in shearing mode.

A system based on shearing speckle interferometry has been set up to carry out analysis, and display the resulting displacement field and the interferogram in real time. The object under inspection is illuminated with an expanded laser beam. A speckle pattern of the unstressed object is initially captured and stored in a computer as a reference image. The object is then stressed artificially by either mechanical, pressure or thermal methods, which in turn causes the object to deform. The image of the deformed object is acquired and stored as deformed image (fig.L.11.1).

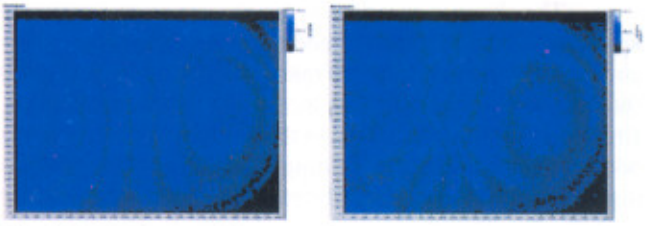

Fig. L.11.1 The specklegram of a normal and a stressed plate

Recording these subsequent speckle patterns, and subtracting them produce an image, which consists of alternating black and white fringes. The fringes correspond to the gradient of the deformation and can be used to calculate the out of plane deformation of the object. This system is being developed at CAT as a prototype for NDT feasibility studies.

(Contributed by: S. Raja, A.G. Bhujle; bhujle@cat.ernet.in)

L.12 pH dependent binding of Chlorin-p6 with lipid membranes: A fluorescence spectroscopic study

Studies are being carried out to evaluate the use of Chlorin-p6 (Cp6), a Chlorophyll derivative as a potential drug for photodynamic therapy. Our earlier studies showed that due to the presence of a number of carboxylic groups the hydrophobicity of Cp6 and hence its aggregation depends strongly on pH [*Dutta et. al. Photochem. Photobiol 75 (2002) 488*]. Since binding of Cp6 to lipid membranes and thus its cellular uptake is expected to depend on its hydrophobicity, we investigated the pH dependence of the binding of Cp6, with a lipid membrane (phosphatidyl choline liposomes).

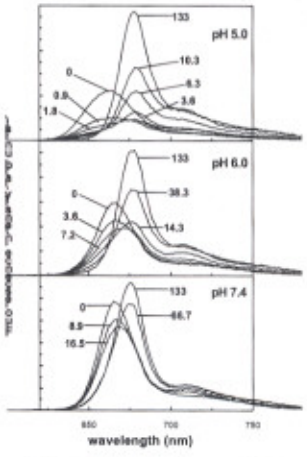

***Fig. L.12.1a** Evolution of the fluorescence of Cp6 with increasing amount of liposome. The increasing numbers indicate increasing amount of liposomes in phosphate buffer.*

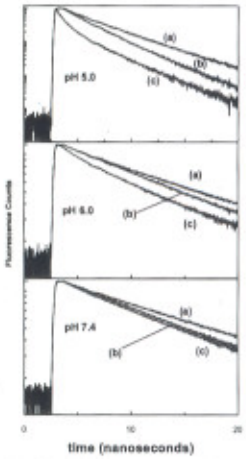

***Fig. L.12.1b** Fluorescence decays of Cp6 in (a) Maximum liposome; (b) No liposome and (c) with liposome concentrations corresponding to numbers 3.6, 14.3 and 16.5 in fig. 1a, for pH 5.0, 6.0 and 7.4 respectively.*