Newsletter

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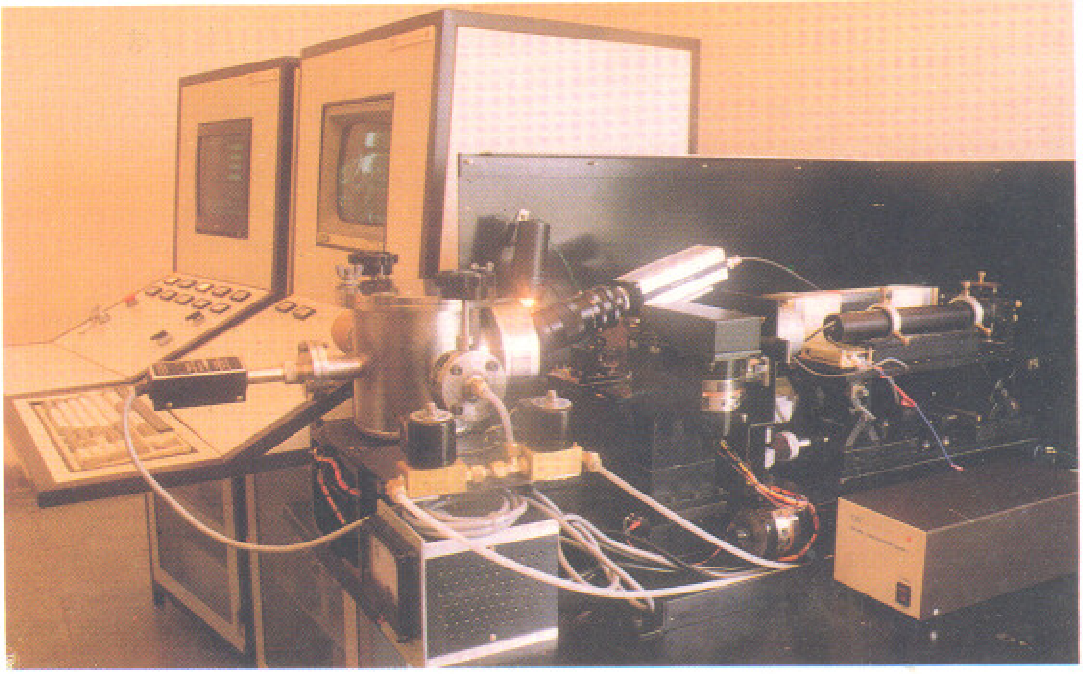

RESEARCH AND DEVELOPMENT

ACCELERATOR PROGRAMME

Commissioning of Injector Microtron

The synchrotron radiation source (SRS) facility being developed at CAT consists of an injector microtron, a 700 MeV booster synchrotron, a 450 MeV storage ring Indus-1 and a 2.0 GeV storage ring Indus-2. The injector microtron is designed to provide an electron beam of 20 MeV and 30 mA a with Kapitza type II cavity, in 22 orbits. In the first phase of commissioning, a Kapitza type I cavity is being used in our microtron. An electron beam of energy 10 MeV and 28 mA current was extracted from the microtron on March 10, 1994. The beam was guided through the transport line near to the injection point of the booster synchrotron on March 20, 1994. Subsequently, an electron beam of 65 mA current was obtained at the extraction port of the microtron on May 21, 1994. It is planned to conduct initial commissioning trials on the booster synchrotron by using this beam. The experiments on the injector microtron with Kapitza type II cavity to achieve 20 MeV will be done after conducting initial commissioning trials on the booster synchrotron.

Growth and roughness characterization of ultra thin films

In the programme for the development of soft x-ray/vacuum ultraviolet optics to be used in synchrotron

Thin film deposition set-up.

radiation, growth of ultra thin films and characterization of their roughness is an important requirement. Ultra thin gold films (100 Å) have been deposited on good quality float glass and on polished quartz substrate. These films were deposited under ultra high vacuum condition using a turbo molecular and sputter ion pump based physical vapor deposition system, made in CAT. The deposition rate was maintained at 0.2 Å/sec. The in situ thickness and deposition rate were monitored using a quartz microbalance. This system is to be used for the development of multilayer reflectors for soft x-ray synchrotron optics.

The gold films were characterized using x-ray reflectivity measurements at 8.047 keV. With these measurements an estimate of root mean square (rms) surface roughness and the thickness of the films was obtained to an accuracy of a few Å. The data shows that the rms roughness of the gold film deposited on float glass is about 6 Å which agrees well with the results in other laboratories abroad on this type of float glass, while the film deposited on quartz polished in CAT optical workshop showed an rms roughness of about 15 Å. The thickness of the thin film was monitored with Å level accuracy with the help of Kiessing fringe oscillation observed in the x-ray reflectivity measurements. The thickness measurement using these oscillations are in good agreement with the in situ measurements done using quartz microbalance.

Gas flow proportional counter detector system for synchrotron radiation beamline

Gas flow proportional counters are soft x-ray detectors used in synchrotron radiation based experimental stations. This type of detector system has been developed and is to be used on the soft x-ray reflectometer station being set up on the metrology beamline of Indus-1. The detector has a 25 micron diameter tungsten wire as anode and uses P-10 (90% Ar + 10% CH_4) gas as the detection media. It has a thin aluminized mylar window. The energy resolution of the detector is 17% at 5.9 keV and can be operated upto 6000 counts/sec without significant deterioration in resolution. The high count rate performance is limited due to the preamplifier (BARC P-117) and the spectroscopy amplifier (ECIL 572 B). Efforts are underway to make the detector compatible to high vacuum and to increase the count rate performance.

Sine-bar mechanism for selection of wavelength in Indus-1 beam line

Synchrotron radiation from Indus-1 will have a broad wavelength range. For selecting a particular wavelength required for an experiment a monochromator is used in which, by tilting the gratings, a suitable wavelength is selected.

As an example, in the radiometry beam line, the wavelength range is 40 to 1000 Å for which 3 gratings of different groove densities are used. These cover the wavelength ranges of 40 - 120 Å, 120 - 360 Å, and 360 - 1000 Å. Selection of wavelength is required in steps of 0.1 Å, 0.3 Å and 0.9 Å in the three ranges respectively. With the given groove densities, this requires angular displacement of gratings in steps of 0.0033 degree. For giving this fine movement a novel sine bar mechanism was designed and developed. The mechanism consists of a bar having two cylindrical surfaces at its ends. The bar is suspended at one cylinder and other cylindrical end is given linear motion through a linear feedthrough. The bar is connected to grating holder such that the reflecting surface of the grating passes through the axis of rotation of the bar. The linear displacement of the free end of the bar is directly proportional to the sine of its angular displacement, and thus to the wavelength diffracted by the grating. A linear motion of 10 μm provides wavelength changes in the three ranges.

The mechanism has been tested using an autocollimeter and an accuracy of 1 arcsec in 10 arcsec angular displacement has been observed.

LASER PROGRAMME

Surface melting of stainless steel using Multibeam CO_2 Laser

The high power multibeam CO_2 laser developed at CAT was successfully used for surface melting of AISI304 SS. This work was undertaken for IGCAR, Kalpakkam. The multibeam CO_2 laser is a slow flow type laser with six equispaced beams on a circle. Each beam has a diameter of 9mm.

For surface melting, the sample pieces were mounted on a motorised translation stage and the six laser beams were focussed on the samples using a zinc selenide lens. Focal spot of 1mm diameter was used. A jet of argon gas