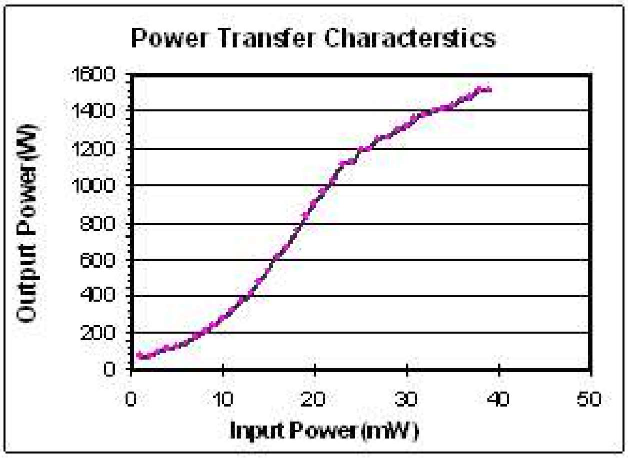


*Fig. A.5.3 : Measured performance at 350 MHz*

Various measurements (power transfer characteristics, effect of bias voltage etc.) of designed units have been done using high power directional coupler, RF dummy load, power meter and spectrum analyzer. Measured VSWR of this unit was 1.09 with power gain of 45 dB for complete chain. Measurements results for power transfer are shown in Fig.A.5.3.

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## A.6 : Structural characterization of low-Z containing thin films using soft x-ray resonant reflectivity

Fine structure features of energy dependent atomic scattering factor near the atomic absorption edge is used for characterization of low-Z containing hard-condensed matter thin films. Near the atomic absorption edge, reflectivity provides increased sensitivity to particular interface of constituent elements due to tunable contrast of optical constants. This is illustrated through the characterization of boron carbide ($B_4C$) thin film and $B_4C$/iron bilayer deposited on float glass substrate.

Optical constants of $B_4C$ undergo sharp variation with energy near boron K-edge (Fig.A.6.1). Near the edge, there is a sharp jump in ß (absorption index) while δ (refractive index decrement) dips to a negative value (anomalous effect). The measured optical constants of $B_4C$ were obtained from best-fit results of soft x-ray reflectivity (XRR) measurements of 80 nm $B_4C$ thin film. Far from the boron absorption edge (for 173 eV, 180 eV and 200eV), measured values of optical constants agree with Henke et. al. [B. L. Henke, E. M. Gullikson, and J. C. Davis, At. Data Nucl. Data Tables 54, 181, (1993)] within the experimental error of ~7 %. At the absorption edge, optical constants deviate significantly (~38%) from Henke et. al. At the absorption edge, these discrepancies in optical constants are due to uncertainty in the tabulated values.

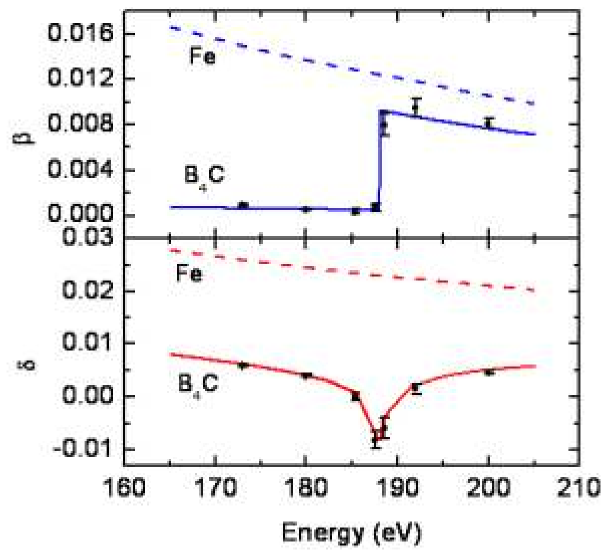


*Fig.A.6.1 : Optical constants for $B_4C$ and Fe versus photon energies near the boron K-absorption edge. Solid circles represent measured values of $B_4C$.*

Results of soft XRR measurements carried out by Synchrotron Utilization and Materials Research Division (using Indus-1 reflectivity beamline) of $B_4C$-on-Fe bilayer film at selected photon energies are shown in Fig.A.6.2 along with fitted curve using Parratt's formalism *[L.G. Parratt, Phys. Rev. 95, 359 (1954)]*. At 180 eV, the amplitude of modulation is smaller compared to 173 eV and 187.5 eV, suggesting relatively lower sensitivity to $B_4C$/Fe interface. The high frequency oscillation gets modulated over the low frequency oscillation marked by vertical dotted line. The high frequency amplitude oscillation with $\Delta q_z^{B_4C} = 0.0096$ Å$^{-1}$ corresponds to the thick $B_4C$ layer, where as the low frequency amplitude oscillation with $\Delta q_z^{Fe} = 0.031$ Å$^{-1}$ corresponds to the thin Fe layer. At 185.3 eV, the refraction index of $B_4C$ is very close to refraction index of vacuum. This makes the $B_4C$ layer almost invisible at this energy and low

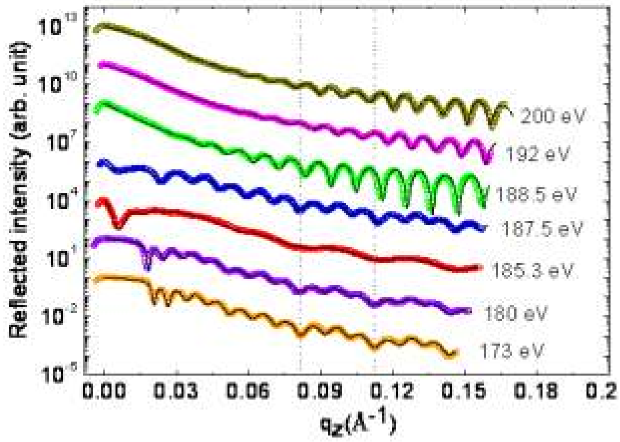


*Fig.A.6.2: Soft XRR spectra of $B_4C$ on Fe bi-layer film tuning photon energy near boron K-absorption edge using Indus-1 synchrotron radiation. Solid circles represent experimental data and the continuous line represents fitted value.*

frequency oscillation reflect information of Fe layer. At 188.5 eV, 192 eV and 200 eV, bilayer effect is not observed due to significant absorption of radiation in $B_4C$ layer. As the energy increases, amplitude of intensity modulation is observed at higher $q_z$ values due to increased penetration depth. The amplitude of oscillation is more at 188.5 eV compared to 192 eV and 200 eV, due to relatively high-reflected intensity of vacuum/ $B_4C$ and $B_4C$/Fe interface. This is due to higher optical contrast at this energy.

The results reveal that soft x-ray resonant reflectivity would be a powerful tool to study selected interfaces of any low-Z containing thin films. This is due to high tunable contrast of optical constants near absorption edge of constituent element.

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## A.7 : First diffraction pattern using Indus-2

We report initial commissioning of a part of the beamline (BL-12), for high-resolution x-ray diffraction on synchrotron radiation source Indus-2. The beamline has been designed using adaptive optics in such a way that it can be commissioned on both bending magnet and wavelength shifter sources, without any design changes. Fig.A.7.1 shows the photograph of the beamline along with the experimental station consisting of a six-circle diffractometer.

*Fig.A.7.1: High-resolution x-ray diffraction beamline with six-circle diffractometer.*

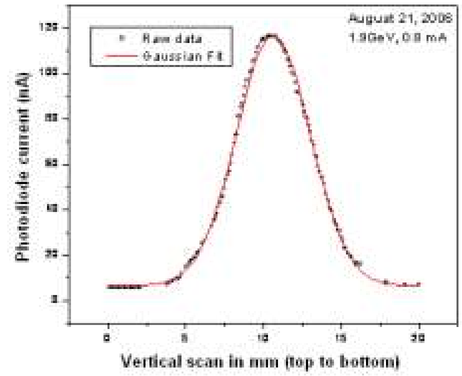


*Fig.A.7.2: Vertical scan of SR beam*

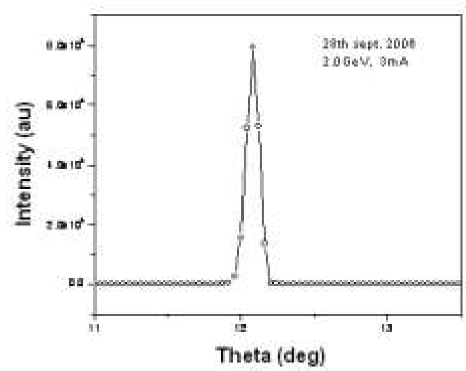


*Fig.A.7.3: The first x-ray diffraction pattern (of pyrolytic graphite) recorded at 8.9 keV using an Indus-2 beamline.*

Figure A.7.2 shows the vertical scan of the SR beam with Gaussian fit at a distance of 20m from the tangent point (FWHM = 0.27mrad). The beamline was aligned up to the exit of double crystal monochromator, without the pre and the post mirrors. Fig.A.7.3 shows the first X-ray diffraction pattern on this beamline, recorded on pyrolytic graphite at 8.9 keV.

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