A.6: A Microprobe-XRF beamline (BL-16) on Indus-2 Synchrotron Source

X-ray fluorescence (XRF) spectrometry is a powerful non-destructive technique for the elemental analysis of materials at the micro and trace level. The technique finds several applications in a variety of fields (viz. geology, archaeology, biomedical science and material science etc.). Apart from the research applications, the technique has potential usages in the industry especially in maintaining the quality control of ultra pure grade chemical reagents and products.

Owing to the numerous advantages of a synchrotron based XRF technique and to fulfill the requirement of Indian universities XRF users, we have setup a microfocus XRF beamline (BL-16) on Indus-2 synchrotron light source. The BL-16 beamline works in the x-ray energy range of 4-20 keV. It provides both micro-focused and collimated beam modes at the experimental station. Using the micro-focused mode of the beamline, it is possible to examine a specimen for spatial distribution of elements. The beamline allows a user to perform energy dispersive x-ray fluorescence (EDXRF) analysis and total reflection x-ray fluorescence (TXRF) characterization of materials at ppb (parts per billion) levels for a short duration of spectra acquisition time. Apart from the elemental mapping, the beamline also offers other modes of XRF characterization, viz. grazing incidence x-ray fluorescence (GIXRF) analysis, chemical speciation, and near-edge absorption spectroscopy etc.

We report here some initial commissioning results obtained using microprobe XRF beamline. The beamline is now operational under optimization mode. A user can access this beamline upon requesting a user beam time.

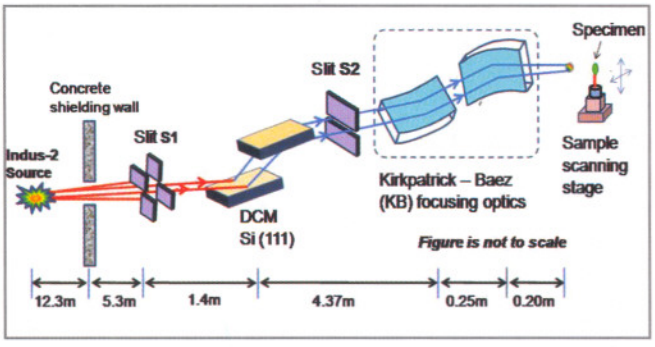

Fig. A.6.1: Schematic layout of the BL-16 beamline.

Fig. A.6.1 shows a schematic layout of the BL-16 beamline. The beamline comprises of a double crystal monochromator (DCM) with Si(111) symmetric and asymmetric crystals (mounted side-by-side), a Kirkpatrick-Baez (KB) focusing optics and the combination of slits in order to reduce the scattered x-ray radiation that pass through the beamline optical elements. It is possible to get either unfocused (i.e. collimated) or micro-focused x-ray beams at the experimental station for fluorescence excitation of a specimen. The experimental station of BL-16 beamline consists of a 5-axis sample manipulator for microprobe XRF-scanning applications, a 2-circle goniometer for TXRF and x-ray reflectivity measurements and a suite of detectors (Ionization chamber, Photodiode, Vortex spectroscopy detector and MiniFdi and VHR x-ray CCD cameras), that makes possible to record a good quality data. Fig. A.6.2 depicts a few representative examples of measured x-ray fluorescence spectra using 15keV collimated synchrotron x-rays. In Fig. A.6.2(a), XRF spectrum recorded from a synthetic standard containing 100 ppm of Zn is presented. The minimum detection sensitivity for Zn was found to be < 1 ppm for spectrum acquisition time of 100 s. Fig. A.6.2(b) shows measured spectrum from a NIST standard (NIST-610) containing several elements in a glass matrix. The spectrum was recorded for acquisition time 300 seconds. Almost all trace elements have been detected in the NIST sample.

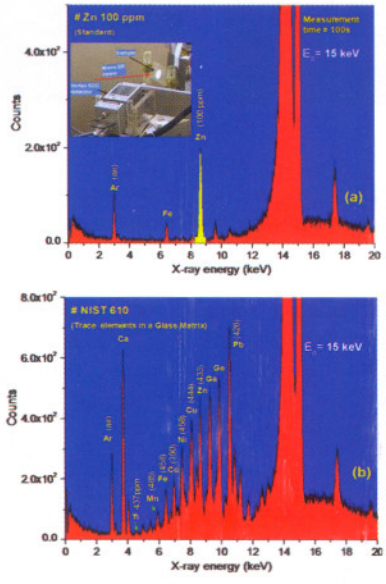

Fig. A.6.2: Measured XRF spectra from standard samples at 15 keV energy. (a) 100ppm Zn standard and, (b) NIST 610 standard (trace elements in glass matrix).

In summary, a micro-focused XRF (BL-16) has been designed, installed and commissioned on the Indus-2 synchrotron source. The beamline enables a wide range of experiments to be performed on it. It is now operational and available for the users.

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