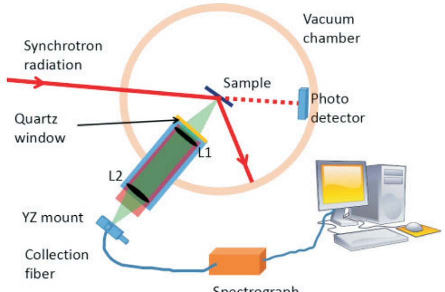
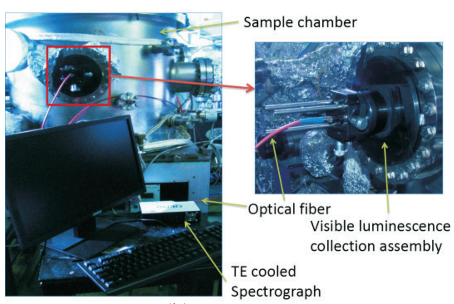
A.10: Development of soft x-ray excited optical luminescence (XEOL) measurement setup at reflectivity beamline at Indus-1

Soft x-ray excited optical luminescence is basically a process in which x-rays excite the atoms/molecules of the sample and subsequent de-excitation gives luminescence in uv-visible and near infrared region. XEOL measurements are widely used for characterizing the luminescence property of photonic materials and also for developing scintillator materials. With the available tunable synchrotron-based x-ray sources, the excitation of materials can be tuned close to absorption edges of elements. Additionally, due to very short absorption length (~100 - 1000 nm), surface specific optical properties of thin films of luminescent materials can be studied. This will provide useful information on the mechanisms of site-specific luminescence and relaxation channels of de-excitation.



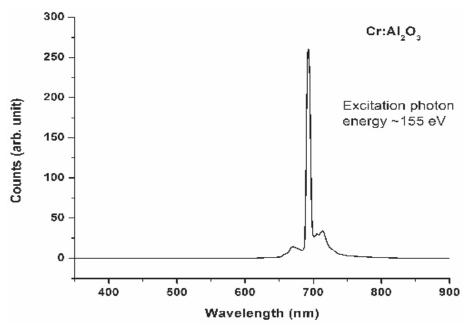
(a)



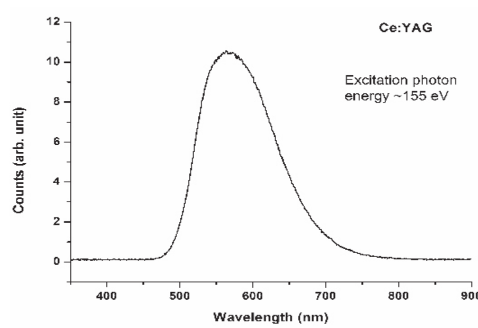
(b)

Fig. A.10.1: (a) Schematics of the light collection assembly for XEOL setup mounted at BL-4 beam line of Indus-1, and, (b) the actual setup.

A setup for the measurement of x-ray excited optical luminescence at the reflectivity beamline (BL-4) at Indus-1 synchrotron radiation source was developed. For this, the existing experimental facility (vacuum chamber) at reflectivity beamline (BL-4) of Indus-1 was modified by attaching an optical system for light collection and detection. Optical luminescence was collected using a lens assembly and focussed on to a ~200 µm optical fibre. The output of optical fibre was then coupled to thermoelectrically cooled spectrometer. The whole luminescence collection system and rest of the vacuum system was isolated with a transparent quartz window. The distance between the sample surface and light collection unit was ~120 mm. It is to be noted that the light collection assembly was designed in such a way that it was mounted via a view port of the chamber and can be removed without affecting vacuum of the experimental station. Schematic of the set up and the developed setup are shown in Figure A.10.1.



(a)



(b)

Fig. A.10.2: XEOL spectrum of (a) Cr:Al_2O_3 and (b) Ce:YAG.

The present setup has soft x-ray excitation in the range of ~10 eV to 300 eV (100 nm - 4 nm) and visible light detection in the range of ~350 nm to 900 nm. The usefulness of the developed setup was demonstrated by the recording the visible emission from standard scintillator materials (Cr:Al_2O_3, Ce:YAG, Eu:YGO, Ga_2O_3 nanostructures, etc.). Representative spectrum of scintillator materials recorded from the setup is shown in Figure A.10.2. The obtained photoluminescence spectra are similar to those reported in literature. The developed material characterization facility of XEOL will be quite useful for developing and designing materials for photovoltaic, laser gain media, scintillators etc.

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