Measurement of low cross section transition using versatile absorption technique

Gaurav Sharma* [1], T. Nandi[†] and Nitin K. Puri* [2]

*Dept. of Applied Physics, Delhi Technological University, New Delhi-110042, India

[†]Inter University Accelerator centre, New Delhi 110067,India

Synopsis The various possibilities of the X-ray absorption spectroscopy is explored in a beam foil experiment. The technique is used for the successful detection of a low cross section process and enhancing the detector resolution which gets degraded due to high intensity ratio. The lifetime measured with the technique matches with the value when absorber is not used.

The versatility of x-ray absorption technique is experimentally explored for enhancing the detector resolution and rejuvenating the very low probable transitions, lost in the pile up region during a beam-foil experiment. The dependence of Beer Lambert's law on the energy plays the key role in measuring the veiled peaks in the spectrum. In a pileup affected x-ray spectrum of collision between 130MeV Ti with 80μg/cm^2 thick carbon target; 4 peaks are successfully rejuvenated. Dependence of absorption coefficient on E^{-3}[1], where E is the energy of incident photons can provide a good tool to handle the intensities of the different energies differently. A transition 10^4 times weaker than one-electron-one-photon (OEOP), possibly originating by filling two-core-vacancies (two-electron-one-photon (TEOP[2]) $1s^{-2} \rightarrow 2s^{-1}2p^{-1}$) in He-like Ti, is detected.

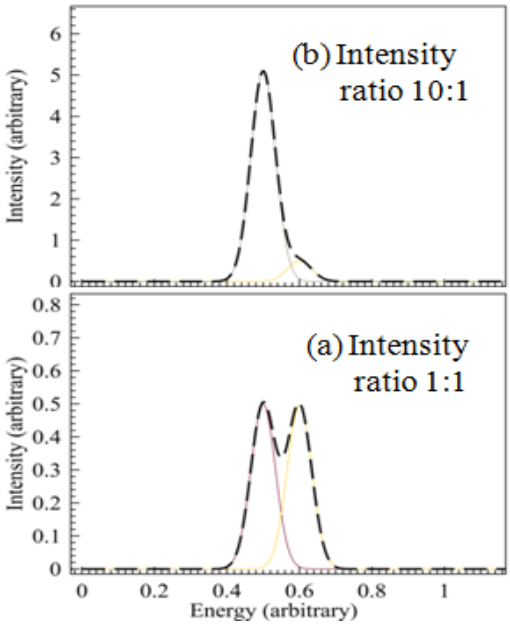

Figure 1. Resolution degradation: Effect of Intensity of the neighbourhood peaks on the resolution of the detector.

Multiple Aluminum absorber layers (10μm each) is used to suppress the pile up and high count rate photons with low energy to rejuvenate the TEOP transition and resolve the K_β and K_α which is obscured due to high intensity ratio and pile-up contamination respectively. We have experimentally confirmed that the lifetime value measured by using this technique (67.11ps) and without absorber (67.34ps) is same within the error limits. The measured branching ratio of this weak transition with OEOP is 1.38E-04. The energy of the spectral lines and the branching ratios of the TEOP/OEOP transitions find potential implications in understanding the multi-electron transitions in ion-solid collisions.

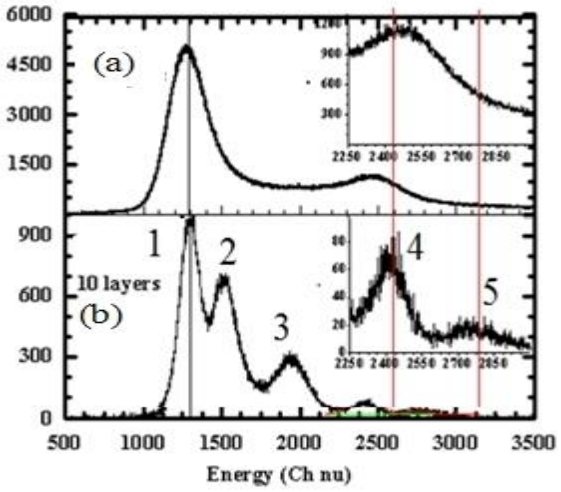

Figure 2. Experimental results: (a) and (b) are experimental x-ray spectrum without and with x-ray absorbers. Part (d) showing new peaks evolved from the spectrum after employing the technique.

References

[1] Newville M 2004 Fundamentals of XAFS *Fundamentals of XAFS* p 1–2 chapter 1

[2] Hoszowska J et.al 2011 *Phys. Rev. Lett.* **107** 053001

[1]E-mail: gaurav.kmc891101@gmail.com

[2]E-mail: nitin.phy@dce.edu