Multiple ionization effects on L X-ray in Bi by proton impact

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Synopsis L X-ray intensity ratios for Bismuth (Bi) as a function of proton energy has been calculated in the energy range 260 – 400 keV. An important phenomenon i.e. Multiple Ionization (MI) effect, which influenced the X-ray production process included in the calculations. These are based on the ECPSSR model using the data basis of different workers. Theoretically calculated values are compared with the experimental measurements and show fairly a well agreement over the entire energy region except at lower energy edge. The present results clearly illustrate the significance of multiple ionization effect and offer relatively good opportunity to bring the theoretical values closer to the experimental measurements.

In atomic and molecular physics, interaction of charged particles with matter has been the subject of extensive study both experimentally and theoretically [1, 2]. In ion-atom collisions various processes can occur like creation of vacancy, filling up of vacancy and lasts with X-ray emission. Analytical technique like PIXE relies on X-ray production cross sections. An accurate knowledge of cross sections has been an increasing requirement, as it plays the great role for solution of many analytical problems [3]. It provides elemental information qualitatively as well as quantitatively over a broad range of elements. The accuracy of cross sections depends upon ionization mechanism along with other parameters viz. Fluorescence yield and Coster-Kronig (CK) probabilities. These parameters are highly affected by the multiple ionization (MI). In view of this, theoretical model with different effects viz. ECPSSR + UA, ECPSSR + MI are employed for calculation of ionization, X-ray production cross sections and their line ratios. Much of this work has been with the heavy ions [4, 5]. But in case of proton, this effect is still largely unexplored. So an effort is made to understand this effect for Bi (Bismuth) due to proton impact within the energy range 260 – 400 keV. Bi is chosen as it is used in the manufacturing of plastics, the synthesis of methanol and as a catalyst. It has wide application in production of low melting alloys used in protective coatings.

We have presented intensity ratios which are calculated with multiple ionization (MI) and without multiple ionization (WOMI) using data sets of different workers [6-9] along with measured values [10] (see figure 1). It clearly shows that how the inclusion of MI effect substantially refines the agreement of calculated and measured values. The detailed results will be presented and discussed at the conference.

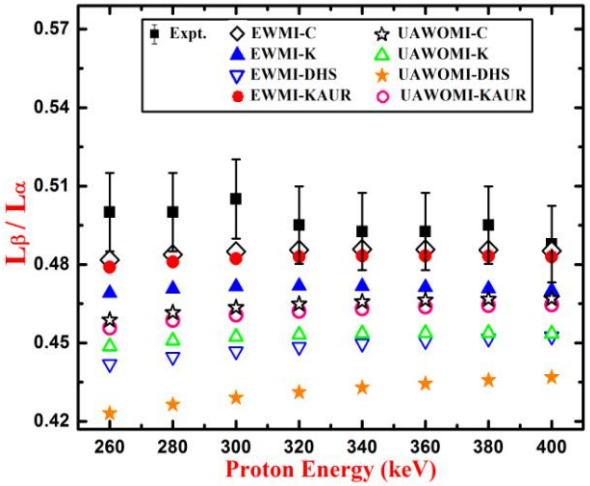

Figure 1. L_β / L_α for Bismuth as a function of proton energy.

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