Investigation of atomic parameters of Tantalum in proton collision

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Synopsis Investigations have been made for L X-ray production cross sections for Tantalum (Ta) bombarded by protons with energy from 260-400 keV. Different phenomenon which alters the atomic parameters has been employed for the refinement of results. Calculations are based on two models i.e. ECPSSRUA and ECPSSR+MI. It is observed that the results of ECPSSR+MI are in the better agreement with the experimental values than the calculations with ECPSSRUA.

PIXE (particle induced X-ray emission) requires the accurate knowledge of X-ray production cross sections resulted from the ionization. With the support of this effect, even in the important technique like PIXE, one is able to perform *ab initio* calculation of elements qualitatively as well as quantitatively in a consistent manner. Comprehensive understanding of ionization demands for multiple ionization (MI) effect. Actually, when the charged particle interacts with the matter it induces multiple vacancies in the inner shells through the outer shells. The multiple vacancies created in the outer shells act as spectators and may not all be filled prior to the radiative filling of inner-shell vacancy [1]. Consequently, nuclear charge reduces and results in the increase of binding energy of all energy levels. Thus leads to the change in (a) Fluorescence yields (b) Coster-Kronig probabilities. Benka [2] indicated that the multiple ionization affect the inner-shell Fluorescence yields and is regarded as an important consideration if X-ray spectra are to be evaluated. It means modification of atomic parameters seems necessary. Lapicki *et al.* [3] suggested a rigorous method to look over these yields in an appropriate manner so as to account this effect. The revised parameters along with ionization cross sections are used to calculate ion induced X-ray production cross sections and intensity ratios. Over the years, several research groups have studied this effect (MI) for heavy ions as induced particle [4,5]. Limited studies have been performed for lighter ions. So, an effort is made to understand this effect for the Tantalum (Ta) bombarded with proton at the energies varying from 260 to 400 keV as shown in Figure 1. Calculations are performed in two models i.e. ECPSSRUA and ECPSSR+MI. It shows that there is a good agreement between the experimental values and those theoretical predictions that including MI affect. It clearly demonstrates that how the inclusion of MI effect improves the results and can be consider as major contributor for accurate evaluation of X-ray spectra. The detailed results will be discussed during the conference.

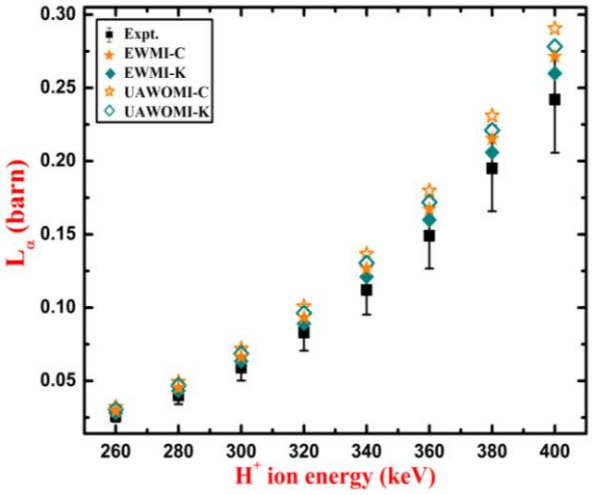

Figure 1. L_α for Au as function of proton energy.

References

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