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Synopsis We present stopping power measurements of Zn for C and O ions and compare them with a theoretical description given by the Transport Cross Section - Extended Friedel Sum Rule (TCS-EFSR) for the valence electrons, and two different models for the inner-shells: the Shellwise Local Plasma Approximation (SLPA) and the CasP approach. The SLPA, which successfully applies to projectiles from H to B, is slightly high for C ions and clearly overestimates the data for O ions. On the other hand, total stopping results using the CasP description for the inner-shells show good agreement with the data for C and O ions, and also with the SRIM predictions.

For increasing projectile atomic number, the stopping power shows a characteristic tendency to higher and displaced values of the stopping maximum [1]. By performing a systematic study for different ions: H, He, Li, Be and B [1-3], we could explain these changes reaching very good agreement between the experimental and theoretical results. The theoretical method consists in separate calculations for the contributions of target valence electrons and inner-shells, by combining two theoretical models: a non-perturbative scattering model using the Transport Cross Section Extended Friedel Sum Rule (TCS-EFSR) [4], and the Shellwise Local Plasma Approximation (SLPA) [2].

In the present contribution we analyze the stopping of Zn for C and O targets with a double purpose. On the experimental side, we present new stopping power measurements that fill a vacancy in the projectile-target combination and cover an extend energy range including the stopping maximum. On the theoretical side, it represents a test on the applicability of the SLPA for C and O ions around 1 MeV, which approaches the validity limit for a perturbative model. Instead, an alternative combination of two non-perturbative descriptions is undertaken: the close coupling calculation with the CasP code [5] for the inner-shells, and the TCS-EFSR for the valence electrons.

Our study shows that the SLPA model can describe stopping of Zn for H to C projectiles but clearly overestimates the O case. Instead, by introducing the CasP calculations for the inner-shells, the stopping power data for C and O in Zn is described, reaching a very good agreement for energies above 100 keV/amu. We analyze these results in terms of non-perturbative conditions and saturation effects.

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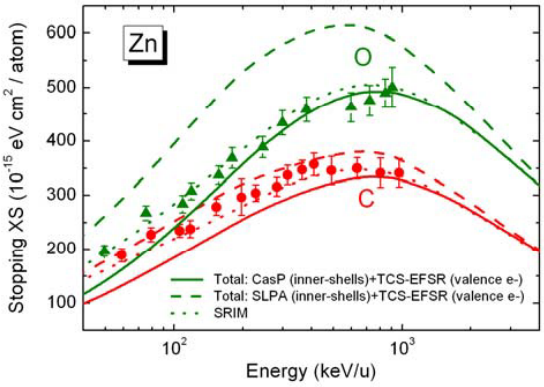

Figure 1. Stopping cross sections of Zn for C and O ions. Symbols: filled circles and triangles, present data for C and O respectively. Curves: notation in the figure, the same for C and O ions.

The energy loss determinations were done by the Rutherford backscattering technique at the 3 MV Tandetron of the Instituto de Fisica da Universidade Federal de Rio Grande do Sul, Brazi. The targets were made of a multilayered Au|Zn|Au film deposited on Si wafers, as in previous works [2-3].

References

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