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The theoretical studies on the electron-impact single ionization of Se^{3+}

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Synopsis We have performed fully relatively level-to-level distorted-wave (LLDW) calculations for both direct ioonization (DI) and excitation autoionization (EA) of ground state Se^{3+} ion using the flexible atomic code (FAC). Large EA contributions come from the excitations 4p to n*l* and 3d to n*l*. Our calculated total DI+EA cross section have been compared with the recent experimental results. It suggests that the contributions of resonace-excitation double-autoionization process (REDA) to electron impact single ionization of Se^{3+} at the near threshold are more than 25%.

Electron-impact ionization is one of fundamental atomic process in hot dense plasmas occurring both in astrophysical and laboratory plasmas. Accurate atomic data including electron impact ionization (EII) cross section are of great importance to model and interpret the structure and dynamics of these plasmas, since one of the key steps in these studies is the knowledge of the charge state distribution.

Selenium is an important element in astrophysics. Recently, Alna'washi *et al.* [1] measured the absolute electron-impact single and multiple ionization cross-section using the dynamic-crossed-beams technique from threshold up to 1 kev and compared their experimental results with the Lotz semi-empirical formula prediction for direct ionization of the 4s and 4p subshells. Thus, no completed theoretical cross sections are available for comparison with the measurement.

In this work, we report fully relativistic lelel-to-level distorted-wave (LLDW) calculation for both direct ionization (DI) and excitation autoionization (EA) of Se^{3+} ion, by using the Flexible Atomic Code (FAC) [2]. In the EA calculation, the collisional excitation cross section is multiplied the explicit autoionization branching ratios [3].

For the single ionization threshold of the ground state for Se^{3+}, the present FAC result is 42.32 eV, NIST reference value of 42.95 eV, the experimental ionization onset is 42.2 ± 1.8 eV. The figure 1 shows the present calculated electron-impact single ionization (EISI) cross sections for Se^{3+} and the experimental results [1]. DI calculation included the contribution from direct removal of a 4p, 4s, 3d electron. $4s \to 4f, nl, (5 \le n \le 20, l \le 5)$ EA, and $3d \to nl, (4 \le n \le 20, l \le 5)$ EA were included into the calculation. The various important components to the total EISI cross section are plotted using colored areas. The gap between the calculation and the experiment from threshold up to 200 eV mainly come from the contributions of resonance-excitation double-autoionization (REDA) process. The REDA calculation are in progess.

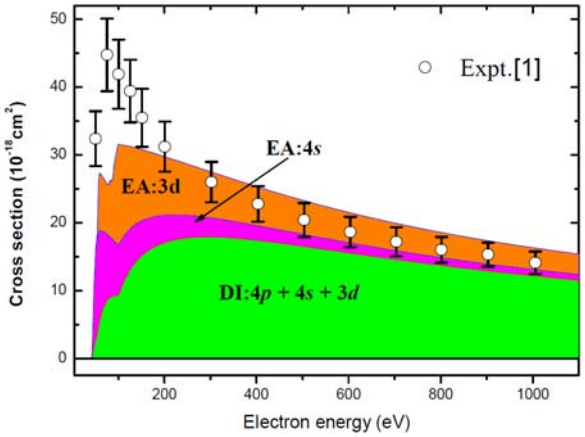

Figure 1. The calculated EISI cross sections for Se^{3+}. The total DI cross section and various EA cross section are shown by differently colored areas. The experimental results [1] are plotted using open circles.

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