Cross sections for electrons scattering from silver at low energies

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Synopsis Differential cross sections for scattering of electrons from silver atoms are calculated in the low energy region using the relativistic Dirac equation. The projectile target interaction is represented as sum of three local and real terms i.e. the static, a parameter free correlation polarization potential and the modified semi classical exchange potentials. We compare our results for differential cross sections with the available calculations and experimental measurements.

Scattering of electrons with metallic atoms provides useful knowledge for understanding their structures and reaction mechanism in terms of cross sections [1, 2]. This information is of great value in the field of astrophysics, radiation physics, plasma and biomedical sciences. In the present study, we have considered electron scattering with silver atom in low energy region. The reason for choosing silver as a target atom is that it has the highest thermal and electrical conductivity with the number of applications. It is a precious metal that has been used for many years to make fine pieces of jewellery and coins.

Our goal here is to use the relativistic Dirac equation for calculating the differential cross sections (DCS) at energies 10, 15, 20, 30 and 100 eV. The motion of the projectile electron in a central field $V(r)$ is described by the Dirac equation given as:

$$[c\alpha.p + \beta m_0 c^2 + V(r)]\psi = E\psi$$

where $E = m_0\gamma c^2 = E_i + m_0c^2$ is the total energy of incident electron, $\gamma = (1 - v^2/c^2)^{-1/2}$ and E_i is the kinetic energy of incident electron. α and β are the 4 x 4 Dirac matrices. The spinor ψ has four components and $\psi = (\psi_1, \psi_2, \psi_3, \psi_4)$, where (ψ_1, ψ_2) are the large components and (ψ_3, ψ_4) are the small components of ψ. The total interaction between an electron and the target atom is approximately represented by an effective potential which can be expanded in terms of symmetry-adapted function of the A_1 irreducible representation (totally symmetric).

$$V_{\text{eff}}(r) = \sum_{l,h} V_{l\,h}(r)\, X_{l\,h}^{A_1}(r)$$

In spherical approximation, we need only the first term ($l = 0$, $h = 1$) in the expansion of above equation, in order to evaluate all potential terms. The details of the potentials i.e. the static (V_{st}), the exchange (V_{ex}) and the polarization (V_{pol}) potentials are given in our earlier work [3]. We have displayed our DCS results at 100 eV (in Figure 1) along with other calculations and measurements. Present results are in good agreement with the experimental measurements compared to other calculations. Detailed results will be discussed in the conference.

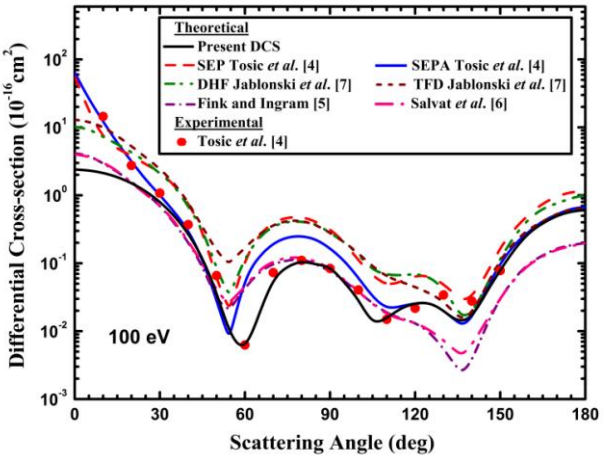

Figure 1. Differential cross section for e – Ag scattering at 100 eV.

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