Excitation of silver by electron impact

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Synopsis Differential cross sections for electron impact excitation of the 5*p* state of silver have been measured in conjunction with relativistic distorted-wave calculations.

We have investigated the excitation of the ground $4d^{10}5s$ state of Ag to its first excited $4d^{10}5p$ state both experimentally and theoretically. This excited state has two fine-structure levels with total angular momentum $J = 1/2$ and 3/2. These levels cannot be distinguished in the present experiment and measurements are presented for excitation of the combined levels. However, we have calculated differential cross sections (DCS) for each level separately and present these as well as comparing the combined results with the measurements.

The experimental apparatus and working conditions for obtaining a silver atom effusive beam have been described elsewhere [1]. DCS measurements are done at impact energies of 10, 20, 40, 60, 80 and 100 eV and from 2° to 10° and from 10° to 150° scattering angles.

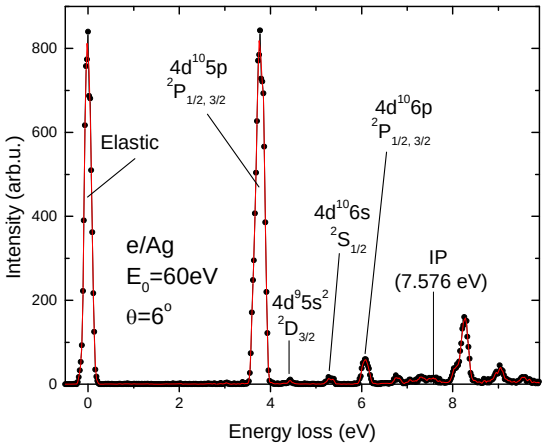

Figure 1. Energy loss spectrum for incident electron with an energy of 60 eV scattered through an angle of 6°.

In figure 1 we show a typical energy-loss spectrum for 60 eV incident electrons which have been scattered through 6°. The signal for excitation of the first excited state is large and well resolved. Still, the most pronounced excitation peak contains two levels, with $j = 1/2$ and 3/2. Different normalization procedures are applied in order to put measured DCSs on an absolute scale.

We have carried out relativistic distorted-wave (RDW) calculations [2] for the excitation of the separate fine-structure levels of the 5*p* state of Ag. The target wave functions were calculated by the MCDF program with a dipole polarization potential. Separate wave functions were obtained for the 5*p* orbitals with total angular momentum (orbital plus spin) $j = 1/2$ and 3/2. The DCS for 60 eV impact energy are shown in Figure 2.

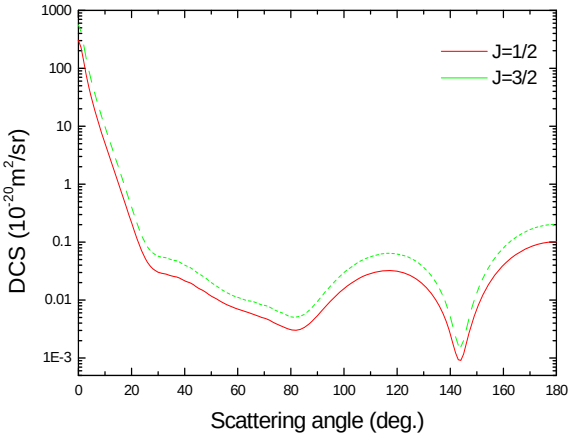

Figure 2. RDW DCS for the excitation of the fine-structure levels of the 5*p* state of Ag.

Although the ratio of the DCS for the two fine-structure levels is close to a factor of 2, it is not exactly so indicating the relativistic effects of having different orbitals for the two fine-structure levels.

References

[1] S. Tosic *et al*, 2009, *NIMB* **267**, 283
[2] T. Zuo *et al*, 1991, *J. Phys. B* **24**, 2447

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