

Coincidence measurements following 2p photoionization in Mg

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Synopsis Triple Differential Cross-Section (TDCS) measurements have been made to investigate the 2p photoionization of Magnesium. In the experiment the photoelectron and the $L_3-M_1M_1$ Auger electron have been detected in coincidence at four distinct photon energies from 7 to 40 eV above the 2p threshold. Auger decay is usually treated as a two-step process, where the intermediate single hole-state makes the link between the photoionization and decay processes. These measurements allow the investigation of the process as a function of excess energy, and specifically to test the validity of the two-step model as the ionization threshold is approached.

Photon induced Auger decay depends on both photoionization, the first step, and the subsequent non-radiative decay which results in the emission of an Auger electron. Generally, the angular distribution of the Auger electron depends on both the alignment of the core hole state and the contributing Auger decays. In particular cases, such as Mg $2p_{3/2}$ photoionization followed by $L_3-M_1M_1$ Auger decay, only a single partial wave can contribute to the Auger decay and a measurement of the angular distribution of the Auger electron yields information about the alignment of the core-hole state [1]. This particular case led to a complete experiment, in which the dipole matrix elements were determined at a photon energy of 80 eV, without measurement of the spin of the electrons involved [2]. Similar information about the dynamics of the photoionization process [1] can be achieved by coincidence measurements of the photo- and Auger electrons, by a proper choice of the photoelectron angle.

In the present work the $2p_{3/2}$ photoelectron and the $L_3-M_1M_1$ Auger electron of Mg have been measured in coincidence after angle and energy selection. The experiments were performed with the multi-coincidence end-station of the Gas Phase beamline at Elettra. This set-up contains ten hemispherical analyzers mounted on two independently rotatable arrays. In these experiments both arrays, hosting seven and three analyzers respectively, were mounted in the plane containing the polarization vector, ϵ , of the linearly polarized incident light. Three of the analyzers were fixed at 0, 30 and 60° with respect to ϵ , whilst the other seven, also mounted at 30° intervals, were rotated in the

plane perpendicular to the direction of propagation of the incident beam. This arrangement allows three TDCS data sets to be obtained simultaneously.

The TDCS measurements have been made at four distinct photon energies, 65, 72.5, 80 and 100 eV. The 80 eV measurements allow a direct comparison with previous measurements [3]. The data analysis is ongoing and a preliminary TDCS is shown in figure 1. It displays the predicted axial asymmetry around the polarization direction [1]. The predictions based upon a two-step model, are expected to become less valid as the photon energy is reduced and final state interactions, such as post-collision interactions, become significant.

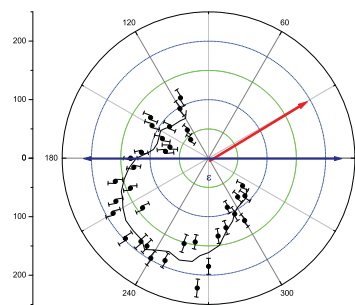


Figure 1. Preliminary TDCS measured at a photon energy of 80 eV. The photoelectron was detected at 30° with respect to the polarization axis (ϵ) and is indicated by the arrow. The angle of emission of the Auger electron is indicated by the polar angle. The solid line is a smoothed representation of the data.

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References

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