Decay of inner-shell holes in potassium and rubidium investigated by multielectron spectroscopy

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Synopsis A magnetic bottle time of flight spectrometer is used to investigate single photon multiple ionization of potassium and rubidium atoms. Results on the decay of the 2p hole in K and of the 3d hole in Rb are presented.

Multielectron coincidence technique is a very efficient way to investigate multiple Auger decay following inner-shell ionization [1, 2]. Thanks to coincidences, each decay pathway can be distinguished clearly providing thus precious information on the branching ratios for the corresponding decay mechanism.

We developed a homemade resistively heated oven in order to extend to alkali atoms the studies done on rare gas atoms. Our experimental setup consists in a magnetic bottle time of flight spectrometer that collects almost all electrons up to ~200eV in 4π solid angle. At higher kinetic energy, this collection angle decreases regularly. The detection efficiency of the electron detected by microchannel plates is estimated within 50-70%. This allows an efficient detection of up to four electrons in coincidence. The energy resolution is ΔE/E=1.5% and depends on the length of the tube (here 2.1m). The experiment was carried out at the PLEIADES beamline of the SOLEIL synchrotron facility.

In the first part, we present multiple Auger decay following 2p inner-shell ionization of potassium atoms. Relative abundances of K^{2+}, K^{3+} and K^{4+} ions that follows respectively simple, double and triple Auger decay are determined. By comparing these results to Argon [3], we find that the decay of the 2p hole in K via a double or a triple Auger is respectively 2 times and 3 times higher than in the case of the decay of the Ar 2p hole [3]. This is explained by the presence of the valence 4s electron in K and it highlights the key role of the electron-electron correlation in the decay mechanism. In addition we look for the energy correlation among the electrons emitted in triple Auger decay. Dalitz plots [4] are used to represent the energy sharing between the three Auger electrons.

In the second part, we present results on multiple Auger decay following 3d inner-shell ionization of Rb atoms [5]. By applying a retardation potential on the tube, the resolution of the recorded Auger spectrum is increased and results are compared with a non-coincident Auger spectrum [6].

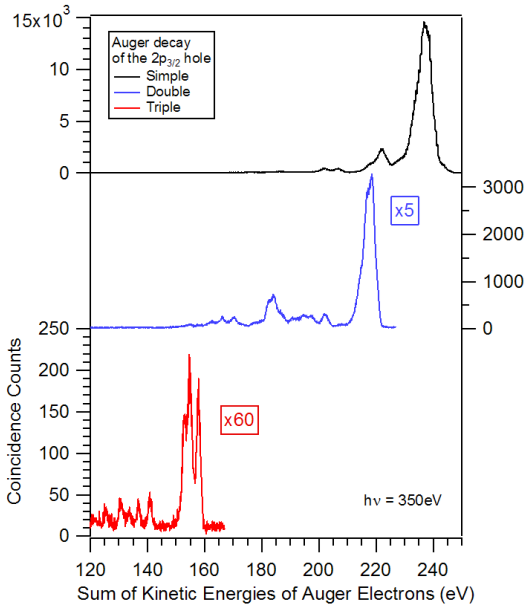

Figure 1. Auger spectra for the Auger decay of a K 2p hole by emission of one, two or three Auger electrons.

References

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