Cross Sections for Inner-Shell Ionization by Electron Impact

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Abstract. Cross sections for the removal of atomic inner-shell electrons by electron impact are needed in many branches of physics including atomic physics, plasma physics, radiation physics, material analysis by electron-probe microanalysis, surface analysis by Auger electron spectroscopy, and thin-film analysis by electron energy-loss spectroscopy in the electron microscope. We have performed an analysis of measured and calculated cross sections for inner-shell ionization as well as of cross sections from a number of widely used predictive formulae [2-5]. The emphasis in our analysis is on the recent formulation of the distorted-wave Born approximation by Bote and Salvat [1] which has been used to generate an extensive database of cross sections for the ionization of the K shell and the L and M subshells of all elements from hydrogen to einsteinium (Z = 1 to Z = 99) by electrons and positrons with kinetic energies up to 1 GeV [6].

We will present examples of our analysis of measured and calculated cross sections for K-shell ionization. We used the calculated cross sections to assess whether the measured cross sections showed the expected energy dependences, as judged by Fano plots [7]. We identified 26 elements for which there were at least three sets of independent measurements that were consistent with each other and that showed energy dependences which were generally consistent with those expected from the calculated cross sections and the Bethe formula for inner-shell ionization [8]. Illustrative plots will be shown to indicate the degree of agreement between calculated and measured cross sections as well as the agreement between the calculated cross sections and those expected from the predictive formulae.

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