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The role of the partner atom and resonant excitation energy in ICD in rare gas dimers

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Synopsis We show experimental evidence for Interatomic Coulombic Decay (ICD) in mixed rare gas dimers following resonant Auger decay. A velocity map imaging apparatus together with a cooled supersonic beam containing Ar_2, ArNe and ArKr dimers was used to record electron VMI images in coincidence with two mass selected ions following excitation on five resonances converging to the Ar^+ $2p_{1/2}^{-1}$ and $2p_{3/2}^{-1}$ thresholds using the synchrotron radiation. The results show that the kinetic energy distribution of the ICD electrons observed in coincidence with the ions from Coulomb explosion of the dimers depends on the partner ion and resonant photon energy.

Experimental evidence for the Interatomic Coulombic Decay (ICD) process in homogeneous and heterogeneous rare gas dimers following Resonant Auger (RA) decay is presented. It is shown that the ICD process can be "controlled" by the choice of the partner atom in the dimer or by the choice of the resonance to be excited before the RA decay process takes place. The experimental apparatus used in this work is a modified electron velocity map imaging spectrometer [1] and linear time-of-flight spectrometer mounted on opposite sides of the interaction region where the tunable synchrotron light from the Elettra storage ring interacts with a liquid nitrogen cooled beam formed by co-expansion of a mixture of rare gas atoms. The velocity map image of the low energy electrons (< 15 eV) formed is then detected in coincidence with either one or two mass selected ions. The resulting image can then be inverted using the standard Abel type inversion techniques and the kinetic energy distribution of the filtered electrons can be extracted. A small demonstrative subset of this data is shown in Figure 1. Here we show the low energy electrons formed in coincidence either with two Ar^+ ions (black trace) or one Ar^{2+} ion (red trace) following excitation of the $2p_{3/2}3d$, $2p_{3/2}4d$, and $2p_{3/2}5d$ resonances, respectively. The important point to note is how the kinetic energy of the ICD electrons increases with the increasing n of the resonance excited. This is in agreement with the simple model which attributes to the ICD process the kinetic energy available to the Ar^+ states populated by Resonant Auger process (RA experimental intensities used in the model are taken from [2] and [3]).

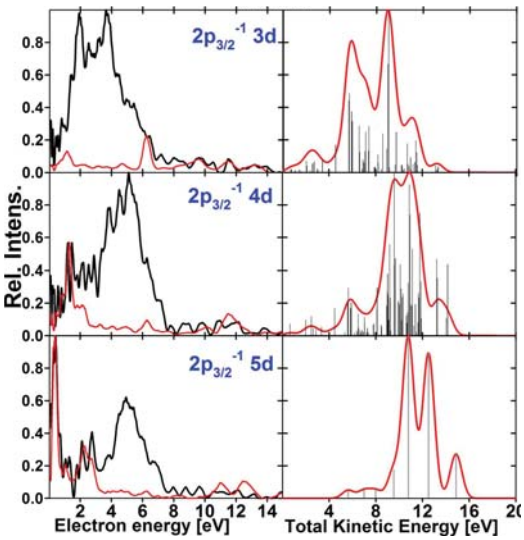

Figure 1. Left panels show the measured electron kinetic energy distributions observed in coincidence with two Ar^+ ions (black trace) and in coincidence with one Ar^{2+} ion (red trace) following excitation of the $2p_{3/2}3d$, $2p_{3/2}4d$, and $2p_{3/2}5d$ resonances, respectively. Right panels show the estimated kinetic energy available for ICD based on a semi empirical model described in the text.

References

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