Electron transfer mediated decay in Ar-Kr clusters

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We have experimentally proven the already predicted [1] existence of three-site electron transfer mediated decay, ETMD(3) [2]. This was made possible by the use of electron coincidence spectroscopy in combination with a magnetic bottle spectrometer.

An independent observation of two-site ETMD(2) has also been described recently by Sakai and coworkers. [3].

[1] Zobeley et al. 2001 J.Chem.Phys. 115
[2] Förstel et al. 2011 Phys.Rev.Lett. 106
[3] Sakai et al. 2011 Phys.Rev.Lett. 106

THE ETMD PROCESS

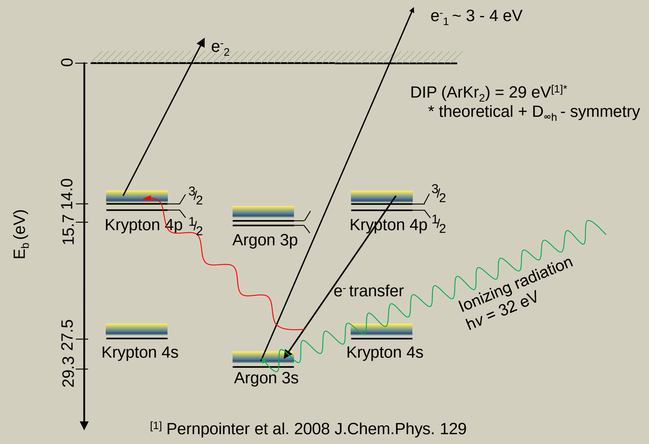


Fig. 1: Diagram of the ETMD(3) process. A vacancy in the Ar 3s cluster band is created by releasing electron e_1. The 3s band is filled via electron transfer from a neighboring Kr 4p electron and ionization occurs at a second, neighboring Kr atom which releases electron e_2.

EXPERIMENTAL SETUP

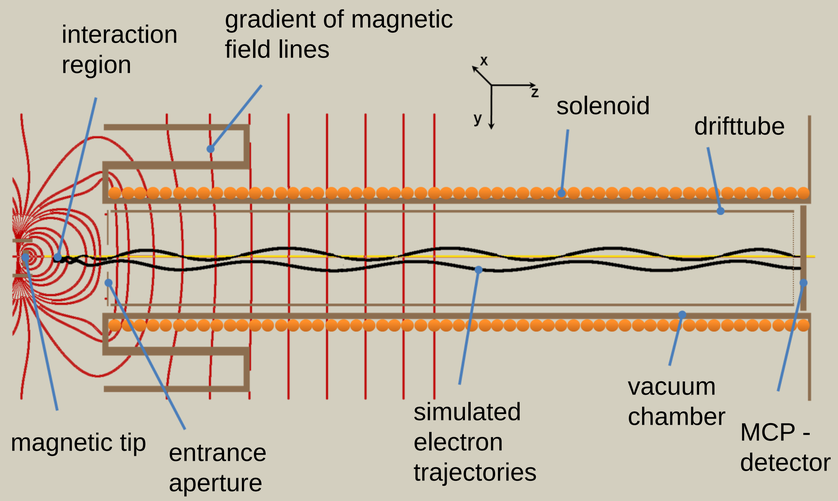


Fig. 2: Schematic of the electron time-of-flight spectrometer including the equipotential lines of the magnetic field and two simulated electron trajectories. A skimmed beam of coexpanded Ar-Kr clusters is crossed with synchrotron radiation in the interaction region.

COINCIDENT ANALYSIS

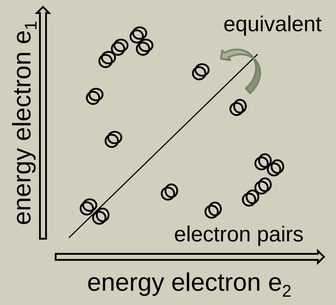
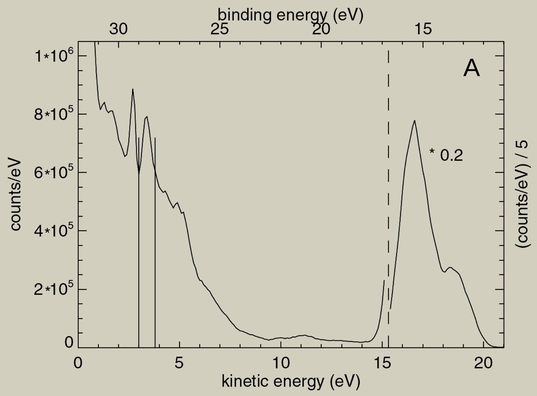


Fig. 3: Graph of a two-electron coincidence map. Every recorded electron pair is histogrammized in $dE(e_1)$ x $dE(e_2)$ intervals. This corresponds to an e_1 x e_2 electron-pair yield per e_1 x e_2 kinetic energy interval. In the following figures we have transformed the e_1 kinetic energy- to a binding energy scale.

RESULTS



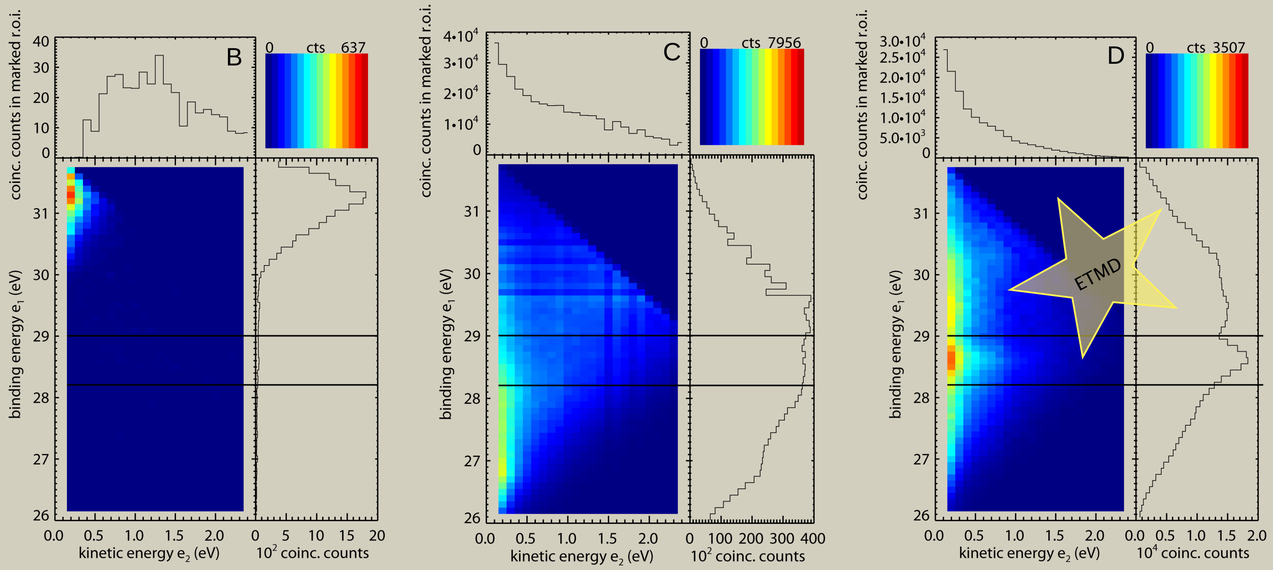


Fig. 4: A; Electron spectrum of Ar-Kr cluster excited with 32 eV. The indicated region between 3 and 4 eV kinetic energy is the Ar 3s cluster band. Figures B to D show 2D histograms of all recorded electron pairs for Argon, Krypton and coexpanded Ar-Kr clusters, respectively. The upper panels show the projection of all events within the marked region onto the axis of e_2. The right-hand panels show the projection of all counts onto the axis of e_1. Figure 4D shows a high electron-pair yield in the (Ar 3s cluster electron x 0..1) eV kinetic energy interval.

OUTLOOK ETMD VS. ICD

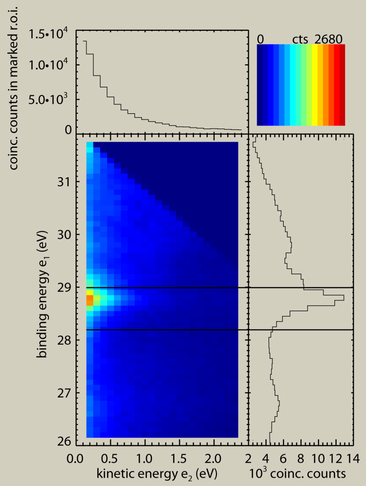


Fig. 5: Coincidence map of Ar-Xe mixed cluster. In this system, depending on the cluster size, ICD as well as ETMD might be allowed.

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