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A new electron spectrometer for synchrotron experiments on size-selected cluster ions

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Clusters show a strong size-dependence of their chemical properties. An example is the high catalytic activity of small Au clusters deposited on different substrates. However, any interaction with a substrate alters their properties. To understand the origin of the size dependency, data on free clusters are needed. These could be valence band photoelectron spectra of reacted clusters. In such experiments, a size-selected cluster ion beam intersects a synchrotron beam and the generated photoelectrons are detected. The advantage over laser experiments is the higher photon energy, which is sufficient to study the adsorbate-induced structures at binding energies between 15-20 eV. However, the intensity of the synchrotron radiation is too low for the use of conventional electron spectrometers with typical detection efficiencies of < 1%. Therefore, such experiments normally require laser radiation. In 2018, we developed a new type of magnetic-bottle electron time-of-flight spectrometer. There is no inherent limitation on the collection efficiency. It may be possible to detect virtually all electrons generated at the beam intersection. It can be combined with a continuous light source or a pulsed laser. The maximum energy resolution depends on the length of the instrument. At two meters it is of the order of 1%. The magnetic field serves as a shield against background electrons, making the new instrument suitable for experiments on samples with low target densities.

Primary author: Prof. GANTEFÖR, Gerd (University of Konstanz)

Co-author: STROBEL, Christoph (University of Konstanz)

Presenter: Prof. GANTEFÖR, Gerd (University of Konstanz)

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