First spin-resolved gas-phase studies at the ALS

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To perform spin-resolved gas-phase experiments we have developed a new spectrometer system consisting of a time-of-flight (TOF) electron energy analyzer [1,2] combined with a retarding field Mott detector [3]. This instrument allows very effective data acquisition, because all electron lines in the TOF spectrum are spin-analyzed simultaneously with a high signal to noise ratio.

In a first investigation we have measured the spin polarization of the Xe $5p^{-1}\ ^2P_{1/2,3/2}$ and $4d^{-1}\ ^2D_{3/2,5/2}$ photolines parallel to the photon beam. The 5p measurements were primarily used to calibrate the polarization sensitivity (S_{eff}) of the Mott detector. The measurements were performed with linearly polarized light at the AMO undulator beamline 10.0.1 of the ALS storage ring.

Using linearly polarized light one component of the spin polarization vector, the so called dynamical polarization, can be measured. The origin of this electron spin polarization is a quantum mechanical interference effect, as opposed to the transferred spin polarization which originates from spin polarized photons and can be measured only with circularly polarized light. We measured the dynamical polarization in the photon energy range 80-210 eV. Comparison with theory shows a good agreement with RPAE calculations of Cherepkov [4] and also with a semiempirical prediction under 140 eV [5].

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