

IONIZATION OF LARGE MOLECULES WITH SHORT LASER PULSES

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Abstract

The decay dynamics of fullerenes and polyaromatic hydrocarbons (PAH) after femtosecond-laser excitation have been studied experimentally by electron momentum mapping and mass spectrometry. The electron spectra of fullerenes and large PAH-molecules were found to be exponentially decreasing with energy without any distinct peaks outside the photon energy. This is interpreted as a statistical electron emission from a transient hot, highly excited, electron system where vibrations are still cold. The smooth electron distributions observed were shown not to be due to tunneling ionization. The photoelectron distributions showed a prolongation along the laser field polarization axis, which was interpreted as field-assisted thermal ionization. For the smallest molecule in the study, anthracene, a transition to atomic like, above threshold ionization, was observed. Molecular fusion of clusters of fullerenes, formed at liquid nitrogen temperature, after fs-laser excitation has also been studied. Products of up to five fused molecules were observed. The mass spectra are the results of several processes including multiple ionization, evaporation of intact fullerenes and post-fusion C_2 evaporation.

Keywords: Photoelectron spectroscopy, Momentum mapping imaging, thermal ionization, above threshold ionization, molecular fusion, fullerenes, polyaromatic hydrocarbons, femtosecond-laser.