Photoionization of helium nanodroplets doped with rare gas atoms

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Abstract

Photoionization of He nanodroplets doped with rare gas atoms (Rg = Ne, Ar, Kr, and Xe) was studied by time-of-flight mass spectrometry, utilizing synchrotron radiation from the Advanced Light Source from 10 to 30 eV. High resolution mass spectra were measured at selected photon energies, and photoion yield curves were obtained for several ion masses (or ranges of ion masses) as a function of photon energy, which provided a sensitive diagnostic as to whether ions at a particular mass were produced by droplet photoionization or from ionization of background gas. Only indirect ionization of the dopant rare gas atoms was observed, either by excitation or charge transfer from the surrounding He atoms. Significant dopant ionization from excitation transfer was seen at 21.6 eV, the maximum of He $2p^1$P absorption band for He droplets, and from charge transfer above 23 eV, the threshold for ionization of pure He droplets. Many of the trends seen in electron impact ionization of rare gas-doped clusters are seen in photoionization, but the high mass resolution of the work reported here allows for a more definitive identification of the product ions in several cases.