

Formation and reactivity of alkali cluster ions in helium nanodroplets

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Doubly and triply charged alkali cluster ions are formed upon electron ionization of helium nanodroplets doped with these metals. The smallest doubly charged clusters observed in this work, i.e., Na₉²⁺, K₁₁²⁺ and Cs₉²⁺, are a factor of two to three smaller than previously reported. For sodium and potassium dications, the cluster size approaches the Rayleigh limit n_{Ray} for which the fission barrier is calculated to vanish, while cesium dications are even smaller than n_{Ray} , implying that the fissility parameter χ have been somewhat overestimated. The same happens to triply charged Cs clusters, where the smallest one detected, Cs₁₉³⁺, is 2.6 times smaller than previously reported. We present some possible mechanisms responsible for the enhanced formation of clusters with high fissilities [1].

Alkali atoms and clusters react readily with fullerenes and form salt clusters. Ion efficiency curves provide insight into the position of the alkali-fullerene complexes prior to the ionization. Except for atomic Cs which remains on a dimple site at the droplet surface, all alkali (clusters) transfer electrons to the fullerenes and submerge as salts into the droplet. In the case of Na excess metal exhibits a pronounced odd-even intensity pattern which is much less pronounced for Cs.

Fullerene alkali complexes have been considered as materials with high hydrogen storage capacity. With the present setup we can determine the number of strongly bound H₂ molecules from shell closures in mass spectra.

Acknowledgement: this work was supported by the Austrian Science Fund FWF, I978, P26635, M 1908-N36.

[1] M. Renzler et al. Phys.Chem.Chem.Phys. **18** (2016) 10623