Dissociation and Recombination Dynamics of Chromium Molecules in Helium Nanodroplets
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The photoinduced dynamics of chromium dimers and small chromium clusters isolated in helium nanodroplets have been investigated with resonant multiphoton ionization (REMPI) spectroscopy and mass sensitive ion detection [1]. Electronic excitation of ground state \((X^1\Sigma^+_{g})\) \(\text{Cr}_2\) molecules to an excited state \((A^3\Sigma^+_{u})\) induces dissociation into a ground state \((a^7S_3)\) and a metastable \((a^5S_2)\) atom. We find that the ground state atom remains solvated inside the droplet, while the metastable atom migrates to the droplet surface without desorbing from the droplet. This interpretation is based on the spectral REMPI signatures of both dissociations products and supported by density functional theory simulations [2]. We also find that REMPI of the surface located \(a^5S_2\) atom induces recombination of the two \(\text{Cr}\) atoms, which is evidenced by \(\text{Cr}_2^+\) detection. For small \(\text{Cr}\) clusters \((\text{Cr}_{3,4})\), our results indicate that they may be composed of chromium dimers that exhibit the same dissociation and recombination behavior.

This demonstration of quantum state specific dopant locations, photoinduced transitions between solvated and surface locations, and the stable separation of two dopants open a possibility for the investigation of photoinduced chemistry in helium nanodroplets.

References