SPECTROSCOPY OF Mg ATOM-DOPED HELIUM NANODROPLETS

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The technique of Helium Nanodroplet Isolation spectroscopy provides an ultra-cold environment (0.4 K) which can be doped with a variety of chromophores. Due to the unique nature of the droplets, the dopant will reside in one of two distinct trapping sites. Dopants may be solvated inside the droplet, in an environment similar to bulk liquid helium matrices. Or they may float on the surface, where the interaction with the helium is weak enough to give only minimal perturbations. Ancilotto *et al.*[a] have developed a model of solvation, based on the dopant-He pair potential, that uses a dimensionless parameter to determine the location of the dopant. Several systems have been studied so far (alkali, alkaline earths, and some transition and post-transition metals), but the boundaries between solvation and expulsion are not yet clear.

Using LIF spectroscopy, we measured the $3\,^1P_1^0 \leftarrow 3\,^1S_0$ transition of Mg atom-doped helium nanodroplets. An interior location of the Mg can be concluded from the blue shift and line broadening of the transition, which matches spectra of Mg atoms solvated in bulk liquid helium. The transition shows a splitting attributable to quadrupole-like deformations of the helium cavity surrounding the atom. Time-resolved studies show an increase in the lifetime of almost 20%, which can be quantitatively explained by the anisotropic distribution of the helium density surrounding the excited dopant, giving further evidence of solvation. Similar work on Ca atoms by Stienkemeier and co-workers[b] has shown that Ca atoms are surface species. Therefore the border between surface and solvated sites can be explored by studying the interaction of helium droplets with Mg and Ca atoms.

[a] F. Ancilotto, P.B. Lerner, and M.W. Cole. J. Low Temp. Phys. 101, 1123 (1995)
[b] F. Stienkemeier, F. Meier, and H.O. Lutz. J. Chem. Phys. 107, 10816 (1997)