SPECTROSCOPY OF Al ATOMS SOLVATED IN HELIUM NANODROPLETS

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We have performed the first measurement of the $3\,^2D \leftarrow 3\,^2P$ transition of Al atoms in liquid helium, using the helium nanodroplet isolation technique. The LIF excitation spectrum is broadened and blue shifted by amounts comparable to other Al transitions studied in bulk liquid helium, indicating solvation by the nanodroplet. As in the case of solvated Mg atoms, the Al transition shows a splitting attributable to quadrupole-like deformations of the cavity formed in the helium droplet. Time-resolved studies of wavelength-selected emission indicate a fast non-radiative quenching from the $3\,^2D$ state to the $4\,^2S$ state, which involves a transfer of 7000 cm^{-1} in less than 50 picoseconds. We have modeled this system using Hartree-Fock Damped Dispersion generated potential energy surfaces and shown that a ring of helium atoms forms around the node of the Al p_z orbital. We conclude that as the number of He atoms in the waist of the orbital increases, the mixing of Σ character into the Al-He $1\,^2\Pi$ state (as predicted by spin-orbit mixing) decreases. The lack of Σ character corresponds to less Al valence electron density in the *xy* plane, causing an attractive region into which the He atoms can be drawn. This can also be described as a localization of the valence electron in its p_z orbital, occuring to a greater extent as the number of helium atoms increases.