THE EFFECTS OF A HELIUM NANO-DROPLET MATRIX ON THE ELECTRONIC SPECTROSCOPY OF SODIUM DIMERS

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Large liquid helium clusters consisting of several thousand helium atoms are used as a cold matrix ($0.4\ K$) for the formation of sodium dimers in their singlet and triplet states by the successive pick-up of single sodium atoms. Since helium clusters can be utilized as a matrix for the production of novel spin states and other weakly bound molecules, a detailed determination of the matrix-induced effects on the spectroscopy of the guest species is required. Analysis of the LIF spectra of singlet molecules reveal structures that can be attributed to the excitations that are created in the superfluid helium cluster.The vibrational cooling of the sodium dimers is revealed by emission spectroscopy since fluorescence is obtained from states produced in the relaxation of the upper vibrational state. Dopant molecules formed on small clusters do not fully relax to their lowest vibrational state, which provides a useful method for producing a beam of molecules prepared in a given excited state. Desorption of the triplet state sodium dimers from the helium cluster surface allows the acquisition of high resolution, rotationally resolved spectra of the $1^3\Sigma_g^+ \leftarrow 1^3\Sigma_u^+$ transition of Na_2. In addition to bare sodium dimers, complexes of helium and Na_2 are observed in the gas phase by the presence of a high resolution spectrum that is shifted 23 cm^{-1} to the blue of the band origin of the $1^3\Sigma_g^+ \leftarrow 1^3\Sigma_u^+$ transition.