Electronic Spectroscopy in Superfluid Helium Droplets

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As expected from the very beginning, the immersion of molecules in superfluid helium droplets is accompanied by a shift of resonance frequencies [1]. Compared to the other rare gas matrices the solvent shift of helium is rather small and amounts to about ±1% for electronic as well as vibronic transitions.

Besides the solvent shift, the line shape of these resonances is an observable which is known to be sensitive to the helium surrounding. In this respect the electronic origin is of particular interest. Besides singly peaked or multiple peaked origins [2], the shape of individual resonance is of interest. This has been demonstrated impressively for Tetracene with a surprisingly rich fine structure at the electronic origin [3]. In addition surprising modifications have been observed upon variation of the droplet source conditions [4].

In our first study on the line shape at the electronic origin of H_2-Phthalocyanine [5] we succeeded in the simulation of the inhomogeneous line shape and its dependence on the droplet source conditions. In the meantime, further experimental data on this dopant species have been obtained which are in contradiction to the model for the simulation. Since this model is not restricted to H_2-Phthalocyanine as dopant species, the investigation of line shapes has been continued for other dopant species.

In these studies, the experimental parameters are the laser power, the droplet size distribution, and the doping conditions. Observables are the peak position, the line shape, and the line width which all are affected by the experimental parameters. Each of these experimental details may be a tessera in a general model for the simulation of microsolvation of molecules in superfluid helium droplets as expressed by helium induced features in electronic spectra.

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