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Rock and Roll at 0.37 K

Using high resolution IR spectroscopy we study micro aggregation and microsolvation on molecular scale. We have used the exotic environment of superfluid helium nanodroplets to observe the onset of crystal formation and study solvation on a molecular scale. Formed by expansion of a high-pressure helium gas through a small cooled nozzle into vacuum superfluid helium nanodroplets are formed which consists of ca. 6000 helium atoms at 0.37 K. These helium droplets act as “vacuum cleaners” for single molecules that strike them, absorbing them into the cluster interior, where they can meet and bind to others that have arrived before them, forming molecular aggregates embedded in helium. Using high resolution infrared spectroscopy it is possible to record the IR-fingerprint of the molecules inside the transparent helium ball. These fingerprints can be used to study the quantized excitations of the suprafluid helium droplets. Due to the suprafluid nature of the droplet the dopant inside can still freely rotate and vibrate which allows to record an undisturbed vibrational-rotational spectrum . The superfluid helium droplets also act as an ultracold trap which allows to study subsequent molecule aggregation and solvation at ultracold temperatures. It turns that new rules for aggregation and reactions in ultracold environments are found.