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Spectroscopy and Reactions of Hydrocarbon Radicals in 0.4 Kelvin Helium Nanodroplets

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Helium nanodroplet isolation (HENDI) has proven to be a versatile technique for many forms of molecular spectroscopy. Helium nanodroplets provide a medium for studying at 0.4 Kelvin, the structure and dynamics of novel systems such as free-radicals, metal clusters, and molecular clusters. In this talk, I will discuss recent progress towards the application of HENDI for the characterization of hydrocarbon radicals and their reactions with O_2. The infrared spectra of methyl (CH_3), ethyl (C_2H_5), and propyl (C_3H_7) radicals are obtained using a high temperature, low pressure, effusive pyrolysis source for doping the droplets. Comparisons to previous gas phase spectroscopy studies reveal a negligible influence of the helium environment on the structure of these radicals. The pyrolysis source and a gas pick-up cell are used to sequentially dope each helium droplet with a single hydrocarbon radical and a single O_2 molecule. The resulting products of the low temperature reaction between the radical and O_2 are probed spectroscopically downstream from the pick-up zones.