A review will be presented of our work in the spectroscopy of large, cold molecular clusters. Growth of clusters in He droplets at $T = 0.38 \text{ K}$ has been studied. Infrared spectra indicate that ammonia clusters consisting of about $10^4$ molecules have a compact structure and that inner molecules in the clusters have similar hydrogen-bonded coordination as in crystalline ammonia. Compact structures were also obtained in the case of CH$_4$ and HCl clusters. These findings are consistent with ballistic aggregation of particles in the superfluid He droplets. Vibrational and rotational Raman spectra were used to study the state of hydrogen clusters. Clusters formed in expansion of a neat para-H$_2$ gas are solid as evidenced by the vibrational frequency and characteristic splitting of the rotational $S_0(0)$ line. However, clusters of about $10^5$ molecules at estimated $T < 1 \text{ K}$, obtained upon expansion of highly diluted para-H$_2$ in He ($<1\%$) have a singular $S_0(0)$ line characteristic of a fluid state. These results offer prospects for observation of superfluidity in hydrogen, which has long been predicted theoretically, but still eludes experimental confirmation.

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