SPECTROSCOPY AND DYNAMICS OF MOLECULES IN SOLID PARAHYDROGEN

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Solid parahydrogen, a crystal of molecular hydrogen in which nearly all the molecules are in the $J = 0$ rotational state, provides novel matrix for isolation spectroscopy of atoms and molecules.[a,b] Rovibrational motion of molecules embedded in solid parahydrogen is well quantized on account of the weak interactions in the crystal, and of the softness of the crystal being characteristic of quantum crystals. Most of the observed spectral linewidths are one or two orders of magnitude sharper than those observed in conventional rare gas matrices. The sharp linewidths make the parahydrogen crystal an excellent host medium for the study of rovibrational states and dynamics of molecules in condensed phases by high-resolution spectroscopy.

This talk will survey what we have learned from the high-resolution infrared spectroscopy of molecules embedded in solid parahydrogen. The topics include perturbations to rotational motion of dopant molecules, reduction of rotational constants, vibrational dephasing and relaxation, nuclear spin relaxation in condensed phase, and nuclear spin conservation in chemical reactions in low temperature solid. Outstanding questions will also be discussed.

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[a] T. Momose and T. Shida, Bull. Chem. Soc. Jpn. **71**, 1 (1998).

[b] S. Tam and M. E. Fajardo, Rev. Sci. Instrm. **70**, 1926 (1999).