HIGH RESOLUTION INFRARED ABSORPTION SPECTROSCOPY OF THE FIRST OVERTONE PURE VIBRATIONAL TRANSITION $Q_2(0)$ OF SOLID PARAHYDROGEN

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It has been shown that high-resolution infrared spectroscopy is applicable to the zero-phonon transitions of rotons and vibrons in solid hydrogen. Because the pure vibrational transitions $Q_n(0)$ [v=n←0, J=0←0] of solid parahydrogen become infrared-active only upon interaction with residual J=1 orthohydrogen, studies of the pure vibrational transitions under high-resolution provide detailed and accurate information on intermolecular interactions between hydrogen molecules. Here, we report the high-resolution absorption spectrum of the first overtone pure vibrational transition $Q_2(0)$ of solid parahydrogen.

The high-resolution spectrum of the $Q_2(0)$ transition at around 8070 cm^{-1} was observed using a difference frequency laser system[a]. The spectrum shows a complicated spectral feature compared with that of the $Q_3(0)$ transition[b]. The v=3 vibrational exciton was found to be well localized on the parahydrogen molecule next to an orthohydrogen. On the other hand, since the vibron hopping matrix element of the v=2 state is comparable to the energy shift due to the existence of orthohydrogen, the observed rich spectral structure can be interpreted as due to the v=2 vibron hopping over a limited number of lattice sites in the crystal. We will discuss the quantitative analysis of the observed spectrum.

[a] T. Momose, T. Wakabayashi, and T. Shida, J. Opt. Soc. Am. B **13**, 1706 (1996).

[b] R. M. Dickson, T. Momose, T. J. Byers, and T. Oka, Phys. Rev. B **57**, 941 (1998).