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Two aspects of water dynamics will be discussed; (1) intermittent collective motions and fluctuation, their experimental observation, (2) the role of these fluctuations in the water freezing process.

IWAO OHMINE, Nagoya University, Chemistry Department

Water exhibits intermittent collective motions associated with the hydrogen bond network rearrangement (HBNR), accompanied with large fluctuations of intermittent local collective molecular motions. We have made a theoretical analysis on multi-dimensional spectroscopy which may detect these intermittent collective motions, since this method deals with the phase space dynamics of a system. The 2-R Raman spectra obtained for CS2 and Water will be discussed A liquid to solid phase-transition goes through a nucleation process, starting with the formation of an initial nucleus, which then grows into a crystalline structure. Dynamical aspects of the nucleation processes have been explored by various studies. In simulations, simple liquids, consisting of spherical particles, are found to easily freeze to crystals. Water molecules possess strong directionality of hydrogen bonds (HB), forming a disordered three-dimensional HB network (HBN) in liquid state, and water is thus much harder to freeze than the simple liquids. A simulation, recently succeeded to reproduce the pure water freezing, revealed a role of the dynamical fluctuations intrinsic in water HBN rearrangement in a formation of the initial nucleus of the water freezing process, but large parts of its molecular mechanism have been remained unknown yet. In the present work, we use a network analysis and employ order-parameters to establish a clear molecular picture of the fragments, the transformation, the role of collective motions in this process.