

1. The dynamics of vibrational energy relaxation (VER) of the OH-stretching vibration of HOD in liquid-to-supercritical heavy water is studied as a function of temperature and solvent density. The VER rate can be correlated phenomenologically with the average hydrogen-bond connectivity within the random D<sub>2</sub>O-network. This correlation enables the identification of thermodynamic conditions under which spectral diffusion due to hydrogen-bond breakage/formation is much faster than VER.

2. The ultrafast photo-induced decomposition of organic peroxides of the type R<sub>1</sub>-C(O)O-O-R<sub>2</sub> is studied using UV excitation at 266 nm and mid-infrared laser pulses to detect reactant and product species. The results clearly show that vibrationally hot CO<sub>2</sub> molecules are formed via a concerted mechanism where O-O and R<sub>1</sub>-C bond are broken simultaneously.