Temperature dependence of low-frequency response in various liquids

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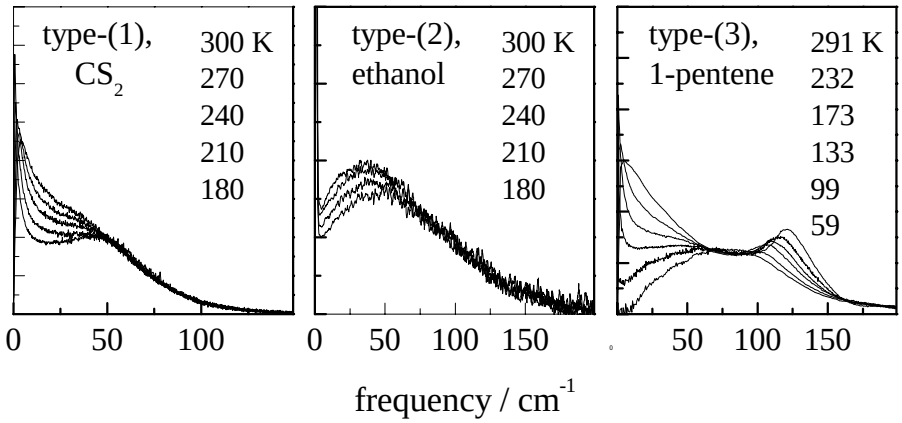
Low-frequency response in liquids shows the drastic temperature dependence especially in the lower frequency region including the relaxational mode. On the other hand, the so-called low-frequency phonon modes in the higher frequency part do not show the strong temperature dependence like the relaxational mode. It seems that the difference of the temperature dependence comes from the different nature of the molecular motions. However, the rational explanation for the temperature dependence has not been given yet and the relations between these modes have not been fully understood.

We have performed Raman scattering experiments in various liquids as a function of temperature. Samples are several kinds of alcohols, CS_2 and several benzene derivatives. Optical Kerr effect measurements have also been performed in three 1-alkene liquids. From these measurements, it is found that the reduced Raman spectra are classified into three categories; (1) CS_2 type, (2) alcohol type and (3) 1-pentene type. In CS_2 type, there exists the clear and strong relaxational mode on the low-frequency phonon mode in their spectral shapes. The relaxational mode (< 5cm^{-1}) and the lower half of the low-frequency phonon modes (< 50 cm^{-1}) show the strong temperature dependence. In alcohol type, there is no apparent component for the relaxational motion in the lowest frequency range observed here. In 1-pentene type, there exist extra components due to the intramolecular vibrational modes. In addition to the lower frequency part, the vibrational mode also shows the strong temperature dependence.

These types of the temperature dependence are discussed from the molecular structures using the model of anharmonically coupled oscillators.[1]

[1] S. Kinoshita, Y. Kai and Y. Watanabe, Chem. Phys. Lett., **301** (1999) 183.



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