Temperature dependence of the low frequency response in liquid and glassy 1-pentene studied by femtosecond optical Kerr effect

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Femtosecond optical Kerr effect (OKE) measurement was performed in liquid and glassy 1-pentene in order to investigate the low frequency material response in connection with the glass transition phenomena. The OKE response was observed in the temperature range between 50 and 290 K while the glass transition temperature is 70 K.[1] The low frequency response function was obtained by Fourier transformation of the observed real time OKE response.

It was found that the material response increases linearly to temperature in the frequency range 10 – 70 cm^{-1} in the whole temperature range examined here. On the other hand, the response below 10 cm^{-1} shows rapid increase, quadratic or more to temperature, above the glass transition temperature 70 K.

The observed temperature dependence of the low frequency response is discussed with the dynamical model of the anharmonically coupled oscillators proposed by S.Kinoshita et at.[2] The model takes into account the forth order coupling for the oscillator amplitude which is the lowest order anharmonicity effective for the response function.

It is shown that the linear temperature dependence is well explained by the lowest order anharmonicity considered in the model. The rapid increase of the response below 10 cm^{-1} suggests that the lowest frequency component of the response comes from higher order anharmonic couplings.

[1] K. Takeda et al., J. Phys. Chem. **99**(1995)1602.
[2] S. Kinoshita et al., Chem. Phys. Lett. **301**(1999)183.