shape of $g_2(\tau)$ indicated the existence of only the pure overdamped capillary waves at the surface of DBP. Furthermore, the decay of $g_2(\tau)$ can be modelled only when the stretched exponential decay scheme is assumed. In this case, the shape of $g_2(\tau)$ can be described by the following formula

$$g_2(\tau) = 1 + g_0 \exp(-2\tau / \tau_0)^{\beta}$$

where g_0 is a contrast, describing the degree of coherence, τ_0 is characteristic time constant, and β is a stretching parameter, which for our data sets was found to be equal to 0.85. Typical $g_2(\tau)$ curves are shown in fig. 1.
Fig.2 summarizes the relaxation times measured for different values of q at different temperatures. The striking feature of all τ_0 vs q curves is that their shape can not be explained using the capillary waves CW approach. To model the data the viscoelasticity of DBP must be taken into account. The Voigt-Kelvin model predicts τ_0 vs q to have following form [3]

$$\tau(q_{II}) = \left(\frac{2q^2\eta}{\omega_s^2 \rho} \right) \Bigg/ \left(1 + \frac{2q^2\mu}{\omega_s^2 \rho} \right)$$

where $\omega_s = \sqrt{\frac{\gamma}{\rho} q^3}$, γ is the surface tension, ρ is the density, η denotes viscosity, and μ is the frequency independent shear modulus. The gravity effect has been neglected in the data analysis.

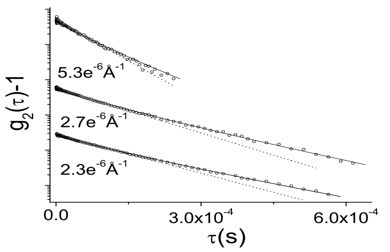

Fig. 1 The $g_2(\tau)$ functions collected at 260K together with corresponding calculated curves for β=0.85(solid), and β=1(dotted) .

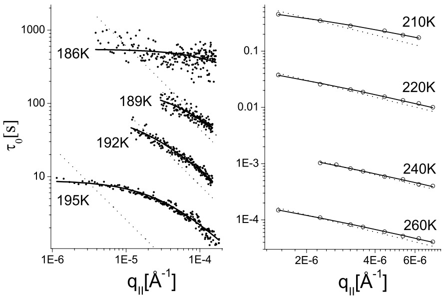

Fig. 2 The τ_0 vs q_{II} data sets collected at different temperatures fitted with capillary waves model (dotted line) and viscoelastic model (solid line).

3. Conclusion

In summary, we report time correlation spectroscopy results of supercooled dibutyl phthalate. The sample clearly shows viscoelastic properties in a broad temperature range. Also the stretched exponential scheme has been observed to govern the relaxation of DBP.

References

[1] T. Seydel, A. Madsen, M. Sprung, G. Gruebel, W. Press, Rev. Scient. Instr. 74, 4033 (2003)

[2] T. Seydel, A. Madsen, M. Tolan, G. Gruebel, W. Press, Phys. Rev. B 63, 073409 (2001)

[3] Z. Jiang, H. Kim, X. Jiao, H. Lee, Y. Byun, S. Song, D. Eom, C. Li, M.H. Rafailovich, L.B. Lurion, S.K. Sinha, PRL 98,227801 (2007)