High Pressure Dielectric Studies of 8CB in the Isotropic, Nematic, and Smectic A Phases

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The static and complex permittivity of 4-*n*-octyl-4'-cyanobiphenyl (8CB) has been measured for the isotropic, nematic and smectic A phases as functions of temperature and pressure. The ranges of 297 - 361 K, 0.1 - 220 MPa, and 0.1 - 13 MHz, were covered. Only the parallel component of the complex permittivity, $\varepsilon^*(f) = \varepsilon'(f) - i\varepsilon''(f)$, was measured. The relaxation times $\tau_{\|}(p, T)$ as well as $\tau_{is}(p, T)$ were analysed at constant temperature, pressure and volume, yielding the activation volume, $\Delta^{\neq}V(T)$, activation enthalpy $\Delta^{\neq}H(p)$, and activation energy $\Delta^{\neq}U(V)$, respectively. All activation parameters calculated for the smectic A phase of 8CB are smaller than those obtained for the nematic phase. The activation energy constitutes approximately half of the activation enthalpy value in all three phases studied. The pressure study allowed to calculate the pressure dependence of the retardation factor $g_{\|}(p, T)$, from which the nematic potential $q(p, T)$ can be derived. Using the relationships between $g_{\|}$ and q/RT proposed by Kalmykov and Coffey, the order parameter $\langle P_2(p, T)\rangle$ was calculated as a function of pressure.

Key words: Liquid Crystals; 8CB; High Pressure; Dielectric; Thermodynamics; Order Parameter.