THE MAXIMUM FLOW ENERGY, A USEFUL WORKING HYPOTHESIS TO APPROACH ORDERING PHENOMENA IN FLUIDS

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The various intermolecular interactions relevant for ordering phenomena in fluids are well defined. They can be subsumed as being ruled by the universally valid variational principle of least action also behind thermodynamics of all reversible processes. Correlations of e.g. the temperature of transition from the nematic to the isotropic phase (T_{NI}) with chemical structure can only be found by demanding computer work. More than 25 years ago the hypothesis was put forward that molecules of an ensemble orient in such a way that the energy being steadily exchanged (flow energy) is maximum. It was helpful to correlate T_{NI} directly with structure, however, initially using an unfit electrodynamic model. In classical form the hypothesis can be given by

$$\int_V \int_t \Pi dV dt = \max. \qquad (I)$$

whereby V stands for the volume in which a process takes place, t for the chronological time and Π for any exchange of energy within V per time unit. In terms of quantum theory exchange means change of quantum description and/or of location. Π has formally the dimension of a power per volume. The solution of the variation (I) seems to be difficult because the tool for a time-ordered integration is lacking and because of the necessity to comprehend also such energy conversions as real that in physics and physical chemistry are treated as imaginary.

Nevertheless, some results in the field of liquid crystals can be related to (I):

a) The rule of "greatest continuity of bond order"[1] that was used to select important classes of compounds for synthesis with respect to their T_{NI}.

b) A quantitative expression for the enthalpy of transition ΔH_{NI} depending on enthalpy $(H_T - H_0)$ and the change of density[1,2].

c) (I) provides an explanation for the heuristically important phenomenon of an exothermic transition from nematic to isotropic[3].

d) A deuterium isotopic effect on the optical nonlinearity (Janossy-effect) of a cyanobiphenyl-based nematic phase doped with an amino-anthraquinone dye could be predicted. Recently, a large effect was found[4], however, explained differently.

e) An additional lift using a mesogenic oil in technical slide bearings was observed explicable by the transition from the isotropic to a liquid crystalline phase[5].

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