NMR of a spinning nematic with thermal fluctuations and topological defects

A.F. Martins* and A. Véron

Department of Materials Science and CENIMAT / I3N, The New University of Lisbon, 2829-516 Caparica, Portugal

We investigate the deuterium NMR response of a nematic confined in a tube rotating about an axis normal to the magnetic field of the spectrometer. For tube rotation speeds above a threshold, the director is set in motion [1] and the NMR spectra then recorded look like a two-dimensional powder spectrum because they are obtained by accumulating many instantaneous spectra taken asynchronously with the director rotation. Such "two-dimensional powder" spectra actually reflect the director distribution over *space and time.* Therefore, a rigorous interpretation of the NMR data requires knowing the real director distribution at any time; this is especially important when one wants to use this technique to evaluate the degree of biaxiality of a nematic liquid crystal. The biaxiality is often related to the shift of the splitting of the inner doublet of the deuterium spectra with respect to its value for an ideal two-dimensional powder of a uniaxial nematic, with uniform distribution. However, one may wonder whether this shift might result from a non-uniform director distribution of a uniaxial nematic. It is the purpose of this work to examine this possibility by simulating the director dynamics in a way that substantially improves upon the usual simple treatment [1]. We use a tensorial approach described in a previous work [2] in order to account for the topological defects. Moreover a stochastic term is added in the 'director' equation in order to account for the thermal fluctuations. We take into account (i) the director anchoring on the tube wall, (ii) Frank elasticity, (iii) occurrence of backflows, (iv) the possibility of creation and annihilation of defects during the rotation of the tube, and (v) the possibility of spatial decoherence of the director rotation induced by fluctuations.

A***cknowledgment:*** *AV acknowledges the financial support of "Fundação para a Ciência e a Tecnologia" through research contract C2007-443-CENIMAT-1.*

References

(*) Author for correspondence; e-mail: asfm@fct.unl.pt

[1] F. M. Leslie, G. R. Luckhurst, H. J. Smith, *Chem. Phys. Lett.* **1972**, *13*, 368.
[2] A. Véron and A.F. Martins, *Mol. Cryst. Liq. Cryst.* **2009** (in press).