

Director-configuration diagram for a closed-cylinder nematic liquid crystal

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This study reports that the director configuration diagram of a closed cylinder of nematic liquid crystal (CC NLC) with normal orientation at the walls may contain four kinds of stable director configurations. Sample cells were prepared by treating all walls of a closed cylindrical cavity with DMOAP (*N,N*-dimethyl-*N*-octadecyl-3-aminopropyltrimethoxysilyl-chloride) and then filling with NLC 5CB. The optical patterns of the CC NLCs were observed between crossed linear polarizers. A theory explaining these observations was developed by calculating the spatial distribution of the nematic director fields. The stable director configurations depend not only on the ratio of the splay and bend Frank elastic constant (K_{11}/K_{33}), but also on the aspect ratio of the cylinder. In general, the occurrence of a transformation between the radial and the hyperbolic type is determined by a critical transformation ratio K_{11}/K_{33} ; there is also a critical aspect ratio remarking the transformation between the point and the ring structure. The calculations predict that the characteristic lengths of both the radial and the hyperbolic ring structure are nearly invariant with respect to K_{11}/K_{33} and the aspect ratio of the cylinder.