2006 Vol.45 No.6 pp.993-999 DOI:

Stability of Disclinations in Nematic Liquid Crystals

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(Received: 2005-9-19; Revised:)

Abstract: In the light of φ-mapping method and topological current theory, the stability of disclinations around a spherical particle in nematic liquid crystals is studied. We consider two different defect structures around a spherical particle: disclination ring and point defect at the north or south pole of the particle. We calculate the free energy of these different defects in the elastic theory. It is pointed out that the total Frank free energy density can be divided into two parts. One is the distorted energy density of director field around the disclinations. The other is the free energy density of disclinations themselves, which is shown to be concentrated at the defect and to be topologically quantized in the unit of $(k-k_{24})\pi/2$. It is shown that in the presence of saddle-splay elasticity a dipole (radial and hyperbolic hedgehog) configuration that accompanies a particle with strong homeotropic anchoring takes the structure of a small disclination ring, not a point defect.

PACS: 02.40.-k
Key words: director field, topological defect, free energy, bifurcation

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