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Two-dimensional study of long rod particles in a nematic liquid crystal with tangential and perpendicular anchorings

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Abstract

In this research, we have investigated the interaction of two identical, very long, and parallel rod particles with planar and homeotropic anchorings in a two-dimensional nematic liquid crystal. The parallel axis of the rods is perpendicular to the nematic field at far distances. The planar and homeotropic anchorings on the surface of particles are perpendicular to the axis of the rods. This nematic field behavior leads to the two-dimensional director around the particles. To this end, we have approximated the study of the interaction of two identical rods in three dimensions to the study of the circular sections of these particles in two-dimensions. The nematic equilibrium field around the circular sections is obtained from the numerical minimization of the Landaude Genns free energy and the surface energy anchorings. The created particles and defects cause short-range and long-range interactions between particles. At far distances, the interaction between particles shows a quadrupole behavior compared to electrostatics. The interaction energy between particles at close contact has a symmetrical behavior around the spatial configuration of 45 degrees, which includes two equilibrium arrangements of the equilibrium configuration at zero and 90 degrees.

Keywords: long rod particles, nematic liquid crystal, two-dimensional calculations, tangential, and perpendicular anchorings, Landau-de Gennes energy

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