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Interaction of a long colloidal particle with a wavy wall in the nematic liquid crystal investigating the effect of wave wall amplitude

F Hoseinirad and M R Mozafari*

Physics Group, University of Qom, Qom, Iran

E-mail: m.mozaffari@qom.ac.ir

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Abstract
This study explores the interaction of a colloidal particle with a wavy wall in a two-dimensional nematic liquid crystal. The particle is confined in a cell between two flat and wavy walls, all with homeotropic anchoring. The particle's interaction with the wall is determined by numerically minimizing the bulk Landau–de Gennes and surface energy using a finite element method. We discovered that within a range of each successive well and hill of a wavy wall, the particle can experience attractive and repulsive interactions, leading it to move along routes determined by energy gradients. The reorientation of the nematic field around the particle from the quadrupole configuration results in anisotropic particle-wall interactions near the wall. We considered the wavy wall with two different amplitudes to explore the impact of the magnitude of wells and hills on interactions. Our calculations demonstrate that increasing the amplitude can strengthen and expand the range of interactions.

Keywords: nematic liquid crystal, wavy wall, Landau-de Gennes energy, surface energy, defect

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