Topological defects in nematic shells on dumbbell-shaped colloidal particles

L.V. Mirantsev
Institute for Problems of Mechanical Engineering, Russian Academy of Sciences - St. Petersburg - Russia

C.B. de Araujo, E.J.L. de Oliveira, I.N. de Oliveira, M.L. Lyra
Instituto de Física, Universidade Federal de Alagoas - Maceió, Alagoas - Brazil

The emergence of topological defects in liquid crystals confined in curved geometries has attracted a remarkable interest over the past decade, due to the possibility of exploring them as an efficient mechanism to obtain self-organized colloidal structures. Nematic liquid crystal shells may constitute a feasible alternative to the designing of building blocks for possible micro- and nanoscopic devices on the basis of new metamaterials, where atoms are replaced by colloids. In these building blocks, local frustrations in the orientation order behave as attractor sites for polymeric ligands, enabling that an effective interaction may take place among colloids surrounded by thin nematic shells.

In this work, we present molecular simulation results of the director field and defect structures in nematic shells on dumbbell-shaped colloidal particles under conditions of degenerate planar anchoring. We discuss the case nematic shell on colloidal particles containing regions with both negative and positive Gaussian curvatures, such as a dumbbell-shaped particle. Our results show that the Gaussian curvature of these surfaces plays a very important role in the number, strength, and spatial location of the topological defects. The influence of a strong external uniform electric field on the defect structures on the dumbbell-shaped nematic liquid crystal (NLC) shells and dumbbell-shaped NLC shells with a central cylindrical insertion was also investigated.