Investigation of electrostatic potential of a helical biomolecule in the Debye-Huckel regime by considering the dielectric inhomogeneity

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Abstract
Inside living cells, many essential processes involve deformations of charged helical molecules and the interactions between them. Actin filaments and DNA molecules are important examples of charged helical molecules. In this paper, we consider an impermeable double stranded charged molecule in the solvent. According to the nature, the dielectric constant of the molecule is considerably different from that of the bulk. In order to calculate the electrostatic potential in the problem in the Debye-Huckel regime, we find the proper Debye-Huckel Green function for the problem. Using this Green function, we calculate the electrostatic potential in the system. Furthermore, we study the dependence of the electrostatic potential on the dielectric inhomogeneity, structural parameters and the salt concentration. This study could shed some light on the role of electrostatic interactions in many essential processes involving charged helical molecules such as actin filaments and DNA molecules.

Keywords: biomolecule, DNA, Green function, Debye-Huckel regime, electrostatic interaction, dielectric inhomogeneity

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