RECENT ADVANCES IN POLYMER VISCOELASTICITY FROM GENERAL RIGID BEAD-ROD THEORY

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ABSTRACT

One good way to explain the elasticity of a polymeric liquid, is to just consider the orientation distribution of the macromolecules. When exploring how macromolecular architecture affects the elasticity of a polymeric liquid, we find general rigid bead-rod theory to be both versatile and accurate. This theory sculpts macromolecules using beads and rods. Whereas beads represent points of Stokes flow resistances, the rods represent rigid separations. In this way, how the shape of the macromolecule affects its rheological behavior in suspension is determined. Our work shows the recent advances in polymer viscoelasticity using general rigid bead-rod theory, including advances applied on the coronavirus. The coronavirus is always idealized as a spherical capsid with radially protruding spikes. However, histologically, in the tissues of infected patients, capsids in cross section are elliptical, and only sometimes spherical. This capsid ellipticity implies that coronaviruses are oblate or prolate or both. We call this diversity of shapes, pleomorphism. Recently, the rotational diffusivity of the spherical coronavirus in suspension was calculated, from first principles, using general rigid bead-rod theory. We did so by beading the spherical capsid, and then also by replacing each of its bulbous spikes with a single bead. In this paper, we use energy minimization for the spreading of the spikes, charged identically, over the oblate or prolate capsids. We use general rigid bead-rod theory to explore the role of such coronavirus cross-sectional ellipticity on its rotational diffusivity, the transport property around which its cell attachment revolves. We learn that coronavirus ellipticity drastically decreases its rotational diffusivity, be it oblate or prolate.

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