Polarization Effects of Dielectric Nanoparticles in Aqueous Charge-Asymmetric Electrolytes

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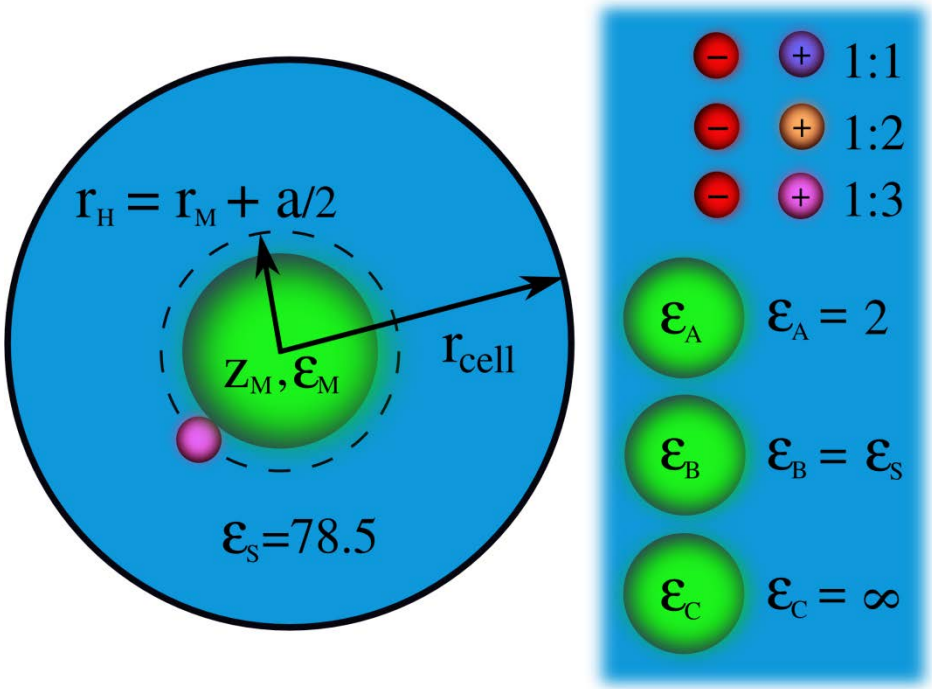

Small nanoparticles, globular proteins, viral capsids, and other nanoscopic biomolecules usually display dielectric properties that are different from those of the medium in which they are dispersed. These dielectric heterogeneities can significantly influence the surrounding ion distribution, which determines the self-assembly and colloidal stability of these nanoparticles in solution. Here, we study the impact of a dielectric discontinuity in the structural and thermodynamic properties of a spherical nanoparticle made of different dielectric materials when it is immersed in a charge-asymmetric 1:z supporting electrolyte. In particular, for trivalent counterions we observe that increasing the dielectric permittivity or the valence of the nanoparticle decreases the critical salt concentration at which occurs a sign inversion of the mean electrostatic potential at the Helmholtz plane, which is closely related to the behavior of the ζ potential and the electrophoretic mobility.

Moreover, we observe that the phenomenon of surface charge amplification, or the augmenting of the net charge of a nanoparticle by the adsorption of like-charged ions on its surface, can be promoted by polarization effects in weakly charged spherical nanoparticles with low dielectric permittivity.

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