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COUPLING OF POISSON-BOLTZMANN EQUATION WITH STOKES SYSTEM: THE FORMATION OF RAYLEIGH JETS

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In an electrolyte solution, such as salt in water, ions are responsible for an increase of the electrical conductance of the liquid. When the ions mobility is large, the distribution of the concentration of ions in the fluid is modelled by Poisson-Boltzmann equation, which is a nonlinear and nonlocal elliptic equation. We prove the existence of solutions to such equation and, more interestingly, deduce asymptotic expansions [1] for the distribution of ions near the interface separating the liquid mass from the outer medium. This allows us to couple in a suitable manner the bulk concentration of ions with Stokes equations to produce an effective model for the evolution of the surface of a drop filled with an ionic solution and subject to electric fields. As an application, we numerically compute the onset of Rayleigh jets emerging from a drop supercritically charged and compute important physical quantities such as their velocity, diameter and total charge. The numerical procedure consists of a Boundary Integral Method.

REFERENCES

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