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Bypassing tedious computations via numerics guided by targeted experiments: The case of a saturation mechanism investigation

Andreas G. Boudouvis
School of Chemical Engineering,
National Technical University of Athens,
15780 Athens, Greece

Abstract

The illumination of mechanisms of wetting of conducting liquids on dielectric solids, due the interaction of electric fields and interfacial tensions, usually requires realistic computations in scales ranging from a few millimetres to hundreds of nanometres or less and particularly in regions where electric field singularities are present. The effect of the field singularities on the dielectric properties of solids is critical since they are connected to physical limitations of electrostatic enhancement of wetting. Direct and securely realistic simulation of the dependence of dielectric properties on high electric field is computationally prohibitive due to the demanding molecular scale computations. However, simple phenomenological relations arising from the interplay between targeted experimentation and continuum computations provide the required accuracy and realism. The core computations involve the solution of the nonlinear partial differential equations of capillary electrohydrostatics with the Galerkin/finite element method. As an example, the illumination of the contact angle saturation in electrowetting is presented and its connection with dielectric breakdown is discussed.

References

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