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Capillary Statics in Nanowedges

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Understanding of capillary transport in porous media is beneficial for a manifold of industries and technologies, which can be exemplified by ink-jet printing, oil and gas production, food production, and water resources research. The geometry of porous media is in most cases tremendously complicated and cannot be always represented by interconnected cylindrical capillaries. Instead, the corner-containing geometries can serve as a more realistic representation of the porous media topology.
The simplest element of the angle-containing structures is an open wedge (corner). It is well known that when the Concus-Finn condition $\theta + \alpha > \pi/2$ relating the contact angle of the wetting liquid θ and the wedge opening angle 2α is fulfilled, the steady state of liquid in the wedge is possible. Otherwise, the rivulet driven by the curvature-induced pressure is expected to propagate infinitely along the corner. However, at the nanoscale, the wetting behavior is drastically affected by surface forces.
To date, the understanding of the nanowetting of the corner geometries is still poor. In the present work, we investigate wetting of the wedge-shaped nanochannels accounting for the surface forces and show that introduction of the latter leads to the appearance of steady state of meniscus in the wedge in the cases for which the Concus-Finn condition is violated. We present and discuss the influence of the surface force parameters as well as the corner geometry on the equilibrium rivulet profile.

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