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Corner wetting during the vapor-liquid-solid growth of faceted nanowires

Abstract

We consider the corner wetting of faceted crystals in the context of vapor-liquid-solid growth of nanowires. Specifically, we construct numerical solutions for the equilibrium shape of a liquid drop on top of a faceted nanowire. Mathematically, the drop/wire geometry is modeled by the Laplace-Young equation with a free boundary involving mixed boundary conditions. Small drops do not touch the perimeter of the nanowire, while larger drops partially wet the perimeter of the nanowire but leave the surface of the nanowire exposed near the corner. As the volume increases further, the behavior of the liquid surface near the corner of the wire is near-singular, with the exposed corner area approaching zero as the drop volume becomes large. With our numerical approach we are able to resolve the near-singular behavior and determine the drop shape in terms of the Young contact angle, the drop volume and the wire cross section. From these numerical results we determine the similarity scaling for the drop shape as it fills the corner of the wire. The implication of these numerical results for steady-state nanowire growth is that there is no equilibrium drop shape that completely wets the corner.