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Spreading and Evaporation of Nanodroplets on Soft and Rigid Surfaces

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Droplet spreading and evaporating on complex surfaces is inherent to various natural and industrial processes. While understanding of the wetting dynamics at the macro- and microscale has essentially advanced over the last decades, nanoscale phenomena still leave many questioned unanswered. Since a droplet of a volatile liquid eventually reaches the state when it is comparable to the range of action of the intermolecular (surfaces) forces, it is important to be able to predict its behavior at this evaporation stage.
In the present work, we use a thin-film equation to model the droplet wetting behavior and employ a one-sided kinetically-limited evaporation model. The intermolecular forces are included in the model using the disjoining pressure concept. The case, when a surface in contact with a droplet is soft, is modeled with the help of an analytical solution from a classical theory of elasticity assuming that the surface is a half-space.
We show that droplets evaporate following neither constant contact angle mode nor constant contact radius mode but rather in a mixed mode. Softness of a surface changes the droplet life-time making it shorter, although does not significantly change the general trend followed by the droplet contact angle.

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