

Interface dynamics of nano-filaments

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Interface dynamics of liquid nano-filaments and their subsequent disintegration into droplets are key elements in many future nano-technologies. In this work, they are studied by molecular dynamics simulations (MD) and stochastic lubrication equations (SLE). In the linear stage, MD simulations are performed that clearly indicate that the classical Rayleigh-Plateau (RP) instability mechanism is violated at the nanoscale. A new theoretical framework based on the SLE is developed that captures MD data and explains why (i) the classical model fails to predict the dominant disturbance mode on interfaces (Rayleigh's result) and (ii) the sharp stability criterion (Plateau's result) is lost. For nonlinear dynamics study, a computational approach is introduced to solve the SLE numerically, which is validated by MD. The SLE simulation is used to investigate the limits of applicability of a similarity solution proposed for this system.

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