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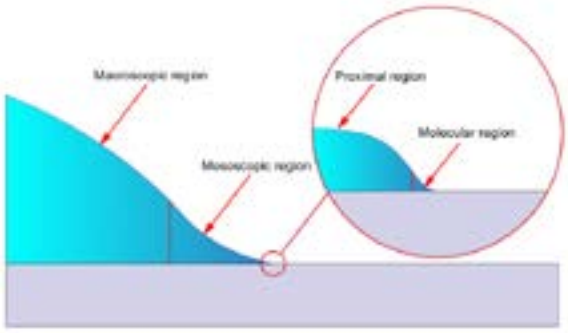
Concave bending of contact line due to polarization and surface trapping

The formation and configuration of three phase (solid/liquid/vapor) contact line is of central importance in understanding wetting dynamics and electrowetting. The contact zone can be divided into four regions: the macroscopic region, the mesoscopic region, the proximal region, and the molecular region. However, the contact angle and the contact line profile within the molecular region still remain obscure. In this study, we used molecular dynamics simulation to examine the contact line profile in the molecular region. It is found that the contact line experiences concave bending at the molecular region, which is induced by the polarization of water molecules therein and the friction among the layered structure of trapped water molecules. The polarization near the solid surface manifest in the form of orientation bias of water molecules. The surface trapping of water molecules in the proximity of solid surface occurs in the form of oscillating peak densities in the density profile. Both effects, which are restricted to approximately 1 nm away from the solid surface, contribute to additional energy dissipation in the process of contact line formation and work jointly as an extra term in the modified Young-Laplace equation.



Biography

Jiangtao Cheng received his bachelor's degree in applied physics from Peking University in 1991. From Purdue University, he earned his master's degree in computer science and his doctorate in physics in 2002. In 2007 he joined the Teledyne Scientific Company (formerly Rockwell Science Center) as a research scientist III for the next four years. He returned to academia in 2011 as an associate professor at the University of North Texas. In Fall 2015, He joined Department of Mechanical Engineering at Virginia Tech as an associate professor. His areas of expertise include: sustainable energy and renewable energy; optofluidics and electrofluidics; microfluidics and nanofluidics; thermal-fluid science and heat transfer; thermal management and microelectronics cooling. Recently Cheng introduced surface plasmon resonance and terahertz technology in to his research in thermal-fluid science. Cheng is on the editorial boards of Aspects of *Nanotechnology and International Robotics & Automation Journal.*

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