Tech Science Press

ICCES, 2024, vol.29, no.1
DOI: 10.32604/icces.2024.011291

PROCEEDINGS

Explore Wetting Dynamics at Micro and Nano Scales: Applications and Progress of Long-Needle Atomic Force Microscope

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ABSTRACT

Contact line pinning and the corresponding contact angle hysteresis (CAH) are important interfacial phenomena that occur in nature and play a significant role in many industrial processes, such as surface coating, ink-jet printing, and immersion lithography. Traditional optical methods face limitations due to the optical diffraction limit, making it difficult to directly measure flow and interface phenomena at the micro- or nanoscale. However, atomic force microscopy (AFM) offers a solution by enabling precise manipulation and force measurements at micro and nano scales. The AFM-based microrheometer, which is assembled with a long-needle probe, can be used to study the dynamics of the gas-liquid-solid three-phase contact line and the micro- and nanoscale flow near the non-ideal fluid-solid interface. In this presentation, the experimental principles and methods of long-needle AFM will be reviewed, along with its latest progress in the study of wetting dynamics at micro- and nanoscale [1-4]. This experimental method provides reliable data for testing various theoretical models and numerical simulations. The application of this technology in emerging fields may inspire us to explore the physical nature of complex phenomena at interfaces.

KEYWORDS

Micro- and nanoscale flow and interfacial flow; three phase contact line; wetting dynamics; atomic force microscopy (AFM); liquid-solid interface

Funding Statement: This work was supported in part by NSFC under Grant No.12372267, by the Key Research Program of Chinese Academy of Sciences Grants ZDBS-ZRKJZ-TLC002, and by the Strategic Priority Research Program of Chinese Academy of Sciences, Grant No. XDB0620102.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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