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Probing Electrified Ionic Liquid-Solid Interface Using Long-Needle AFM

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ABSTRACT

"How can we measure interface phenomena on the microscopic level" is a fundamental question that has been with us for many years and is also listed in recent Science 125 question. It is even harder to explore the electrified interface. In this work, we report atomic-force-microscope measurements of interfacial dynamics of an electrified room-temperature ionic liquid (RTIL)-solid interface. RTILs are intriguing fluids that have drawn much attention in applications ranging from tribology and catalysis to energy storage. With strong electrostatic interaction between ions, their interfacial behaviors can be modulated by controlling energetics of the electrified interface. Using a unique long-needle AFM technique [1-4], we measure contact angle hysteresis (CAH) of a circular contact line formed on a micron-sized fiber, which is coated with a thin layer of conductive film and intersects a RTIL-air interface. The measured CAH shows a distinct transition by increasing the voltage applied on the fiber surface. Molecular dynamics simulations were performed to illustrate variations of the solid-like layer in the RTIL adsorbed at the electrified interface. The integrated experiments and computations demonstrate a new mechanism to manipulate the CAH by rearrangement of interfacial layers of RTILs induced by the surface energetics.

KEYWORDS

Electrified interface, ionic liquid, contact angle hysteresis, AFM

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References

1. Guan, D. S., Wang, Y. J., Charlaix, E., Tong P. (2016). Asymmetric and speed-dependent capillary force hysteresis and relaxation of a suddenly stopped moving contact line. *Physical Review Letters 116,* 066102.
2. Guan, D. S., Wang, Y. J., Charlaix, E., Tong P. (2016). Simultaneous observation of asymmetric speed-dependent capillary force hysteresis and slow relaxation of a suddenly stopped moving contact line. *Physical Review E, 94,* 042802.
3. Guan, D. S., Charlaix, E., Robert Z. Q., Tong P. (2017). Noncontact viscoelastic imaging of living cells using a long-needle atomic force microscope with duel-frequency modulation. *Physical Review*

Applied, 8, 044010 (Editor's Suggestion, Featured in Physics).

4. Guan, D. S., Charlaix, E., Tong P. (2020). State and rate-dependent contact line dynamics over an aging soft surface, *Physical Review Letters, 124,* 188003.