Engineers show dynamic experimental evidence for phenomenon of spreading drops

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The spreading of a liquid drop on a solid surface is a simple, everyday phenomenon. And while it is known that when a drop of oil is placed on a solid surface, its radius increases as its thickness decreases, the mechanisms underlying the process are still not well understood on a microscopic level, particularly at the moving edge between the liquid and solid, which is known as the "contact line" region.

Research in the early 20th century revealed that the edge of a spreading drop emits a microscopically thin layer of fluid, or "precursor film," and scientists in the 1980s developed a theoretical model for this film that considered intermolecular forces close to the contact line. Since then, physicists have tried to capture experimental evidence of the film's behavior and characteristics, an effort made more challenging by the film's nanoscale features.

In a new study, researchers at the Complex Fluids and Interfacial Physics lab at the UCLA Henry Samueli School of Engineering and Applied Science have successfully measured the dynamic evolution of the precursor film using fluorescence microscopy. The work is the first to provide experimental support for the theory governing the precursor film's behavior with respect to time and space.

This study contributes to the body of experimental evidence needed to develop a comprehensive understanding of microstructures at the vicinity of the contact line, and it bridges the gap between computational methods and theory. The research will provide insights into the

fundamental behavior of fluid-spreading and other surface phenomena.

An understanding of the microscopic dynamics of liquids spreading on solids has many potential industrial and technical applications as well, including coating processes, inkjet printing and even cell manipulation.

The research was recently published in the peer-reviewed journal *Physical Review Letters*.

More information: Dynamics of Nanoscale Precursor Film near a Moving Contact Line of Spreading Drops, *PRL*, DOI:10.1103/PhysRevLett.106.254501

Abstract
The spreading of liquids on solids is a commonplace phenomenon, discernible in various instances of everyday life. Despite the apparent simplicity of spreading, the underlying mechanisms are still not fully understood on a microscopic level, particularly at the moving edge between liquid and solid known as the contact line region. Here we show the time-dependent evolution of nanoscale films on a clean solid surface near the moving contact line. Our work contributes to the body of experimental evidence required to assemble a comprehensive understanding of microstructures at the vicinity of the contact line, bridging the gap between computational methods and theory. Moreover, this research will provide insight into the fundamental behavior of fluid spreading and other surface phenomena.

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