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Spreading of volatile oils on swelling hydrophobic polymer brush layers

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Polymer brushes are highly responsive materials that have a broad spectrum of possible applications, therefore an understanding of their interfacial behavior is essential. The degree of swelling of a polymer brush can be influenced by various external stimuli, such as the presence of a solvent. Under good solvent conditions, drop spreading causes changes in the wettability of the brush surface resulting in a finite contact angle. We observe this in a system of hydrophobic poly lauryl methacrylate (PLMA) solvated by a droplet of hexadecane. A halo is visible ahead of the slowly advancing contact line resulting from a gradient in degree of swelling. The width of the halo is the result of a complex coupling of solvent transport between the brush, droplet, and vapor. The time-dependent swelling profile in the halo region is modelled by numerical calculations using gradient dynamics, as extracted from interferometry measurements. Experiments with solvents with various vapor pressures (variable alkane chain length) are performed to further understand the spreading dynamics of a drop on complex surfaces and reveal the mechanism of the halo formation and the wetting phenomena.

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