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Polymer Droplet Dynamic Wetting Measurement at the Nanometer Scale on Smooth Surfaces Using Atomic Force Microscopy MOHAMMADREZA SOLEYMANIHA, JONATHAN ROBERT FELTS[1], Texas A&M University, ANML TEAM[2] — Fluid spreading is a complex phenomenon driven strongly by intermolecular forces that requires nanometer scale microscopy to observe and understand. We present a technique for measuring molten polymer spreading dynamics with nanometer scale spatial resolution at elevated temperatures on sapphire, silicon oxide and mica using tapping-mode atomic force microscopy (AFM). The experimental setup is used to measure the spreading dynamics of polystyrene droplets with 2μm diameters at 115-175 C. Custom image processing algorithms realize the droplet height, radius, volume and contact angle of the droplet over time. The contact angle evolution followed a power law with time with experimental exponent values of -0.26, -0.08, and -0.2 for sapphire, silicon oxide, and mica, respectively at 115 C. The non-zero steady state contact angles result in a slower evolution of contact angle with time compared to Tanner's Law, as expected. We observe local crystallinity on the molten droplet surface, where crystalline structures appear to nucleate at the contact line and migrate toward the top of the droplet. Increasing the temperature from 115 C to 175 C reduced surface crystallinity from 35% to 12%, consistent with increasingly energetically favorable amorphous phase as the temperature approaches the melting temperature. This platform provides a way to measure spreading dynamics of extremely small volumes of heterogeneously complex fluids not possible through other means.

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