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Seeing Below the Drop: Direct Nano-to-microscale Imaging of Complex Interfaces involving Solid, Liquid, and Gas Phases KONRAD RYKACZEWSKI, Department of Mechanical Engineering, MIT & NIST, TREVAN LANDIN, FEI Co., MARLON L. WALKER, JOHN HENRY J. SCOTT, NIST, KRIPA K. VARANASI, Department of Mechanical Engineering, MIT — Nanostructured surfaces with special wetting properties have the potential to transform number of industries, including power generation, water desalination, gas and oil production, and microelectronics thermal management. Predicting the wetting properties of these surfaces requires detailed knowledge of the geometry and the composition of the contact volume linking the droplet to the underlying substrate. Surprisingly, a general nano-to-microscale method for direct imaging of such interfaces has previously not been developed. Here we introduce a three dimensional imaging method which resolves this one-hundred-year-old metrology gap in wetting research. Specifically, we demonstrate direct nano-to-microscale imaging of complex fluidic interfaces using cryofixation in combination with cryo-FIB/SEM. We show that application of this method yields previously unattainable quantitative information about the interfacial geometry of water condensed on silicon nanowire forests with hydrophilic and hydrophobic surface termination in the presence or absence of an intermediate water repelling oil. We also discuss imaging artifacts and the advantages of secondary and backscatter electron imaging, Energy Dispersive Spectrometry (EDS), and three dimensional FIB/SEM tomography.

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