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Nanotextured phase coexistence in the correlated insulator V_2O_3[1]

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The Mott insulator–metal transition remains among the most studied phenomena in correlated electron physics. However, the formation of spontaneous spatial patterns amidst coexisting insulating and metallic phases remains poorly explored on the meso- and nanoscales. Here we present real-space evolution of the insulator–metal transition in a thin film of V_2O_3, the "canonical" Mott insulator, imaged at high spatial resolution by cryogenic near-field infrared microscopy. We resolve spontaneously nanotextured coexistence of metal and correlated Mott insulator phases near the insulator–metal transition (T = 160–180 K) associated with percolation and an underlying structural phase transition. Augmented with macroscopic temperature-resolved X-ray diffraction measurements of the same film, a quantitative analysis of nano-infrared images acquired across the transition suggests decoupling of electronic and structural transformations. Persistent low-temperature metallicity is accompanied by unconventional dimensional scaling among metallic "puddles," implicating relevance of a long-range Coulombic interaction through the film's first-order insulator–metal transition.

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