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Mesoscopic percolation network in a manganite thin film revealed by microwave impedance microscopy KEJI LAI, WORASOM KUNDHIKANJANA, MICHAEL KELLY, ZHI-XUN SHEN, Stanford University, MASAO NAKAMURA, MASASHI KAWASAKI, YOSHI TOKURA, RIKEN, Japan — Using a microwave impedance microscope implemented under variable temperatures and magnetic fields, we discovered a pronounced percolating network with a period of 100nm in $Nd_{0.5}Sr_{0.5}MnO_3$ thin films. The spatially resolved impedance maps vividly demonstrate the microscopic origin of the colossal magnetoresistance effect. Strikingly, the filamentary ferromagnetic metallic domains emergent from the antiferromagnetic charge/orbital-ordered insulating background align preferentially along certain crystal axes of the (110) $SrTiO_3$ substrate. Such mesoscopic glassy orders, partially smeared out by disorder effect, indicate that the substrate-induced anisotropic strain rather than the Coulomb interaction plays the dominant role in the phase separation. The microwave images also revealed drastically different domain structures between the zero-field-cool and field-cool processes, consistent with the macroscopic transport measurements.

Keji Lai
Stanford University

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