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Electronic Phenomena in Correlated Oxides at the nanoscale

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I report current induced metal-insulator-metal stripes and moiré-type phase separation in correlated transition metal oxides at the nanoscale. Mesoscopic periodic textures in Ca_2RuO_4 single crystals and $\text{La}_{0.67}\text{Sr}_{0.33}\text{MnO}_3$ thin films were revealed by infrared nano-imaging and optical-microscopy measurements. Those textures have orientations tied uniquely to the crystallographic axes of the sample or miscut steps in the substrate, implying a strong coupling of the electronic transition to lattice degrees of freedom. I will also use this opportunity to report the recent advances in the infrared (IR) and terahertz (THz) near-field nanoscopy and spectroscopy technologies and discuss their future applications for quantum materials. This includes the recent advances in data analysis and the cryogenic, ultrafast, and multi-modal imaging capabilities. These new developments set the stage for future spectroscopic investigations to access the low energy electron, phonon, and spin dynamics in complex quantum materials at the nanoscale.