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Electron Holography of Nanoscale Electric and Magnetic Fields

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Off-axis electron holography in the transmission electron microscope provides a unique and powerful approach to visualizing electric and magnetic fields within materials with resolutions approaching the nanometer scale. The ability to image phase shifts at medium resolution opens up a wide field of interesting and important materials problems. In this work, the technique has been successfully used to quantify electrostatic and magnetic fields in and around deep-submicron devices and patterned nanomagnets. An important extension of this work has involved in situ application of magnetic fields to image local magnetic response during hysteresis loops. Applications include asymmetric pinning of domain walls at notches in nanowires. Electrostatic field examples include, imaging of electrostatic phase shift at quantum dots to allow for quantification of charge capture and measurement of piezoelectric fields and 2-dimensional electron gas densities.