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NAVIGATING THE NANOWORLD WITH Z-CONTRAST STEM

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Today, with a scanning transmission electron microscope, it is possible to focus a beam of electrons to atomic dimensions, opening up new modes of imaging and chemical analysis. Z-contrast imaging of interfaces and nanostructures provides direct images of atomic arrangements and allows electron energy loss spectroscopy of specific atomic sites. In combination with first-principles theory, this represents a powerful set of tools to link the atomic scale chemistry to macroscopic properties. Five case studies will be presented: 1) Correlation of atomic and electronic structure of the Si/SiO₂ interface and its influence on properties. 2) The origin of electrical barriers at SrTiO₃ grain boundaries. 3) A quantitative explanation of the exponential decrease in grain boundary critical current with misorientation in the high temperature superconductor YBCO. 4) The structure of the decagonal quasicrystal Al₇₂Ni₂₀Co₈ and the origin of quasiperiodic tiling. 5) The functionality of nanotubes and nanocrystals.