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4.6 Electron-Energy-Loss Spectroscopy and Imaging 4.7 Atomic Resolution in an Environmental TEM; 4.7.1 Atomic-scale electron microscopy at ambient pressure by exploiting the technology of microelectromechanical systems; References; 5. 4D Electron Imaging in Space and Time: Principles; 5.1 Atomic-Scale Resolution in Time; 5.1.1 Matter particle-wave duality; 5.1.2 Analogy with light; 5.1.3 Classical atoms: Wave packets; 5.1.4 Paradigm case study: Two atoms; 5.2 From Stop-Motion Photography to Ultrafast Imaging; 5.2.1 High-speed shutters; 5.2.2 Stroboscopy; 5.2.3 Ultrafast techniques
5.2.4 Ultrafast lasers 5.3 Single-Electron Imaging; 5.3.1 Coherence of ultrafast packets; 5.3.2 The double-slit experiment revisited; 5.3.3 Ultrafast versus fast imaging; 5.3.4 The velocity mismatch and attosecond regime; 5.4 4D Microscopy: Brightness, Coherence and Degeneracy; 5.4.1 Coherence volume and degeneracy; 5.4.2 Brightness and degeneracy; 5.4.3 Coherence and Contrast; 5.4.4 Contrast, dose, and resolution; Further Reading; References; 6. 4D Ultrafast Electron Imaging: Developments and Applications; 6.1 Developments at Caltech - A Brief History; 6.2 Instruments and Techniques
6.3 Structure, Morphology, and Mechanics

Sommario/riassunto

The modern electron microscope, as a result of recent revolutionary developments and many evolutionary ones, now yields a wealth of quantitative knowledge pertaining to structure, dynamics, and function barely matched by any other single scientific instrument. It is also poised to contribute much new spatially-resolved and time-resolved insights of central importance in the exploration of most aspects of condensed matter, ranging from the physical to the biological sciences. Whereas in all conventional EM methods, imaging, diffraction, and chemical analyses have been conducted in a static -