Electron Microscopy, a Key Enabling Technology for Nanoscience

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The ways in which cell architecture is modelled to meet cell function is a poorly understood facet of cell biology. However, the compartmentalization of mutually exclusive reactions in different regions of cells by membrane-enclosed organelles or by self-assembling macromolecular complexes is a basic mechanism of life. Fluorescent tags can display proteins confined to compartments in living cells, but provides no glimpse of the underlying ultrastructure. The electron microscope has the resolution to display cellular ultrastructure. Transmission electron microscopy (TEM) tomography of thin slices (~100-300nm depth) can reveal complex subcellular cellular ultrastructure. Serial Block Face Scanning Electron Microscopy (SBFSEM) can provide ultrastructural resolution throughout a much longer (µm to mm) sample depth, enabling quantitative analysis of ultrastructural features throughout the length of most complex cells. These electron microscopy techniques, when combined with cryogenic techniques to prepare tissues can reveal unprecedented levels of insight into biological processes. The 3D datasets are invaluable in basic, applied and translational research. Including the development and application of nanotechnologies.