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Cryo-Electron Tomography: New Views of Cells and Organelles

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Electron microscope tomography (ET) is a non-invasive imaging technique that can provide invaluable and novel information about the three-dimensional (3D) structure of cells, organelles and macromolecular assemblies. In ET a set of projection images from different viewing angles is recorded using a transmission electron microscope. These images can then be used to reconstruct the 3D structure of the specimen using weighted back projection or other algorithms [1, 2]. For meaningful images it is crucial that biological specimens are maintained at a state that resembles their native structure as close as possible. Rapid freezing of cells and tissues can provide outstanding structure preservation and good time resolution of dynamic cellular processes [2, 3]. In the past decade, cryo-ET of frozen-hydrated cells and organelles has emerged as a powerful technique that provides unprecedented images of cellular features in situ. In fact, various studies have shown that cryo-ET in combination with image processing techniques, such as 3D correlation averaging and structural classification, can reveal molecular details of cellular specimen, i.e. relatively thick biological material, at about 2-4 nm resolution [4, 5, 6]. In this presentation I will give an introduction into the technique, discuss strengths, limitations and possible future developments, and describe a few exemplary applications where cryo-ET has produced unprecedented views. Such information can provide unique insights into the structural basis and ultimately the function of many cellular processes.

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