3D Scanning Electron Microscopy Techniques for Bio-medical Research

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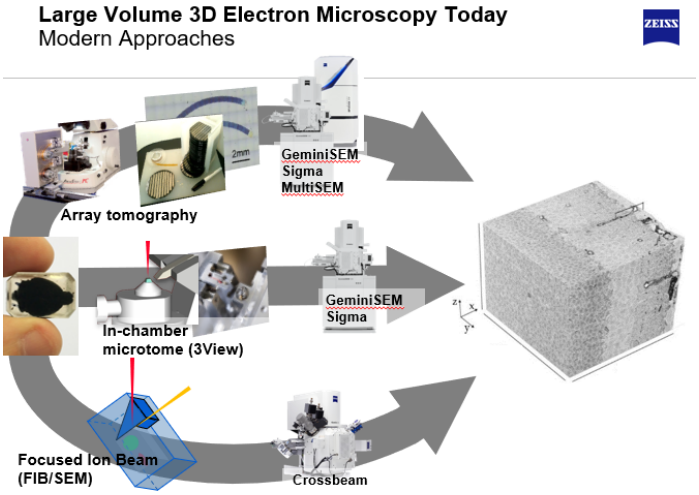
Electron microscopy imaging has been used as a valuable research tool in the Life Sciences for many years. From research of single cell organisms, viruses or eukaryotic cells to identification of synaptic contacts between neurons, the ability to image biological samples in nanometer resolution has proven to be extremely valuable for many areas of biological research. The majority of these examples has been studied using the well-established Transmission Electron Microscopy (TEM) technique.



Recent developments in Scanning Electron Microscopy (SEM) has shown to meet the resolution and imaging quality of thin section preparation of heavy-metal and resin embedded biological specimens. Furthermore, SEM systems offer intuitive, customizable and highly automated workflows which saves time and improves experiment success rates. Recent developments open the spectrum of high resolution and large volume imaging of biological tissue. Based on sample block-face scanning in combination with milling (e.g. Focused Ion Beam (FIB)) or block-face cutting techniques [1], SEM enables dramatic resolution improvements in the third dimension above what is possible with TEM. Furthermore, SEM offers large field of view imaging of organs and whole organisms and hence facilitates applications that have previously been unachievable in the lab.

In addition, 3D SEM techniques are highly automated and offer easy to conduct workflows for correlative studies using light microscopy. These include in particular 3D colocalization of genetic and immunohistochemistry markers and increase the contextual information content of electron microscopy data.

[1] B. Titze, C. Genoud, " Volume scanning electron microscopy for imaging biological ultrastructure", Biology of the Cell, (2016).