

3D Nanoscale imaging with FIB-SEM

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Background

3D nanoscale imaging is essential for understanding numerous processes of high importance for society today. In this project I work on developing ways to use a focused ion beam as a cutting tool together with a scanning electron microscope to image the freshly cut surface, so a 3D model of the sample can be made by cutting and imaging slice by slice through the sample.

The method can be used in several projects with Grøn Dyst angles and I here report on my work on imaging malaria infected blood cells which is essential for a deeper understanding of how the parasite might be targeted by medicine, and algae samples that are essential for ecotoxicological studies and later will be used for algae species used in biomass and biofuel production

Methods

The samples are prepared by fixing the the cells with a glutaraldehyde solution to immobilize the proteins. Then an osmium tetroxide solution is used to both stabilize the lipid membranes and stain the lipids, as the heavy osmium will scatter electrons more efficiently than the surrounding tissue. A uranyl acetate solution and other additional chemicals can also be used to enhance the staining process. Finally the sample is dehydrated in a series of ethanol solutions and at the end embedded in an epoxy and cured at elevated temperature. This process converts the hydrated cellular sample into a dehydrated plastic block with heavy metals stains; that can be cut by the focused ion beam and images by the scanning electron microscope

Results & Conclusion

We find that the FIB-SEM method is capable of providing high resolution approaching 10 nm in three dimensions, and very detailed 3D models can be made of the samples.