

Master's projects in cryogenic electron microscopy | Max Planck Institute of Molecular Physiology, Dortmund, Germany

Three master's projects are available in the Structural Cell Biology group led by Dr. Katerina Naydenova at the Max Planck Institute of Molecular Physiology, located just across the road from the campus of TU Dortmund. Our group develops new methods that improve the capabilities of cryogenic electron microscopy (cryo-EM), especially for radiation-sensitive materials (including, but not limited to, biological specimens). Successful candidates will join a young international team with access to state-of-the-art imaging and structural biology infrastructure.

Project 1: Engineering of electron microscopy specimen supports for cells

A “grid” is the standard specimen support used in electron microscopy now for almost a century. However, a single universal specimen support is poorly suited for all the needs of biology. Specifically, in this project we will design and manufacture specimen supports tailored for preparing mammalian cells for cryo-EM using focused ion beam milling, correlated with fluorescence microscopy. The project will include training in modern cleanroom nanofabrication techniques.

Further reading: [10.1016/j.ultramic.2021.113396](https://doi.org/10.1016/j.ultramic.2021.113396)

Project 2: Measurement of the mechanical stress in cryopreserved biological specimens, prepared for cryogenic electron microscopy

The typical preparation of cells or tissues for cryo-EM involves freezing them and then cutting out a thin section using focused ion beams for imaging by transmission electron microscopy. The success of this method of specimen preparation requires preservation of the structural integrity of the specimen, which is often challenging. In this project, we will measure the mechanical stresses in cryo-preserved biological specimens, and how these stresses affect the strain in the specimen during and after thinning. Understanding the physics underlying these phenomena (much of which is actually the physics of water ice...) will in turn enable us to devise new strategies for preparing improved biological specimens.

Further reading: [DOI: 10.1126/science.abb7927](https://doi.org/10.1126/science.abb7927)

Project 3: Demonstration of a low-cost instrument for cryogenic focused ion beam milling

Cryogenic scanning electron microscopes combined with focused ion beams (cryo-FIB/SEMs) are the most frequently used instruments for preparing thin sections of cryopreserved biological specimens (cells or tissues) for electron microscopy. However, these instruments were historically developed for applications in materials science, and not specifically for biology. In this project, we will demonstrate how one could reduce the cost of the instrument by ~30% while still being able to prepare specimens of equal (or better!) quality.

Further reading: https://doi.org/10.1007/978-1-0716-0966-8_3

Application: Please submit a CV and a 1-page motivation letter. Informal inquiries are welcome. AI-generated application texts will not be considered.

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