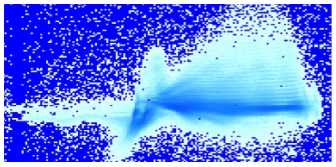

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Electron Holography: A Technique for Phase Plate Optimization

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Electron microscopy is a powerful tool for imaging soft biological samples, providing superior resolution compared to both light and x-ray imaging techniques. Unfortunately, biological samples are weak-phase objects in the electron microscope, providing minimal inherent contrast [1, 2]. This is in part because our detectors are only sensitive to variations in electron intensity and not phase. There are different approaches to overcome these limitations, including heavy metal staining (mass-thickness contrast), defocus phase contrast, and phase plate induced phase contrast.

In this work we are developing thin film based phase plate devices, operating in Zernike and Hilbert mode respectively, to enhance phase contrast at minimal defocus. These phase plates introduce a phase shift of pi/2, or pi respectively, to the scattered beam. The phase shift produced by a thin film is governed by the mean inner potential of the film, the film thickness and the accelerating voltage of the electron microscope [3].

We utilize off-axis and in-line electron holography to characterize the phase shift induced by the thin film material of our devices [4, 5]. Employing the accelerating voltage, the known film thickness, and the measured phase shift, we can determine the mean inner potential for the material [6]. With the mean inner potential in hand we can now produce phase plate devices with the correct thickness to induce the target phase shift. With these devices we will be able to optimize the contrast from a variety of weak-phase objects yielding TEM images with both higher resolution and higher contrast.

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