

# Soft x-ray phase contrast microscopy using a spiral zone plate

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Spiral zone plates<sup>1</sup>, forked gratings, and spiral phase plates have been used in the visible light regime as optical elements because their angular phase pattern is useful for many applications: the generation of optical phase singularities, particle manipulation, interferometry, and microscopy. It was demonstrated in the visible light regime that using these elements as spatial filters is a way to optically implement radial Hilbert transform image processing<sup>2,3</sup>.

Phase sensitive imaging is also useful for contrast enhancement in x-ray microscopy<sup>4,5</sup>. We use the spiral zone plate as a single element objective which is equivalent to optically combining the radial Hilbert filtering operation and the imaging operation into a single step. Spiral zone plates were fabricated using electron beam lithography as seen in figure 1. Initial experiments imaging Gd<sub>25</sub>Fe<sub>75</sub> thin films with perpendicular magnetic anisotropy were performed using a full-field soft x-ray transmission microscope XM-1 at the Advanced Light Source (ALS) in Berkeley. A resulting image showing the edge enhancement is shown in figure 2. This is similar to that of Normanski phase contrast imaging except with isotropic sensitivity. Other x-ray phase contrast microscopy experiments will also be discussed.

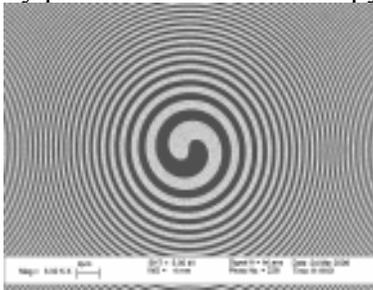


Figure 1

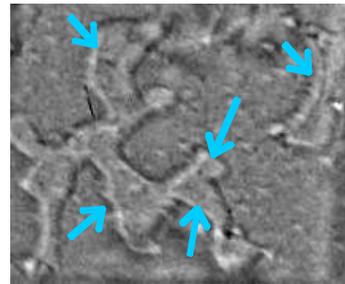


Figure 2

## References

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