

Programmed Phase Defect Fabrication with a Focused Ion Beam

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Introduction:

Programmed defect masks of the pit type have been fabricated using focused ion beam (FIB). These programmed defect masks are important for the characterization of the sensitivity of mask inspection tools for phase defects and for testing of the printability of phase defects. With this technique, pits are milled into the mask prior to the multilayer coating. The flexibility of the fabrication with the FIB allows for easy variation of pit defect size, shape, depth, and sidewall angle.

Method:

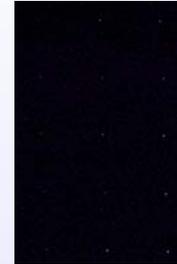
A focused ion beam tool was used to mill pits into the surface of the mask. In order to avoid charging on the surface and allow for fine features, a Mo/Si layer was first deposited for its conductivity. The features were milled into that layer and then for a final phase defect mask, another Mo/Si multilayer would be deposited. The features milled into the mask will be different than the features of the phase defects due to the smoothing during the deposition process. So, the original features milled were made as an array with a large range of sizes and shapes to ensure that some of the final phase defects would cover the relevant range of sizes of interest.

Results:

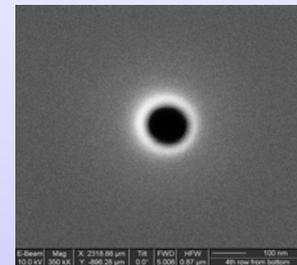
A wide variety of circular holes were successfully fabricated with depths ranging from 10 to 100 nm and widths ranging from 25 to 200 nm. The milling process did not appear to produce any defects near the milled holes from the sputtered material.

Future Work:

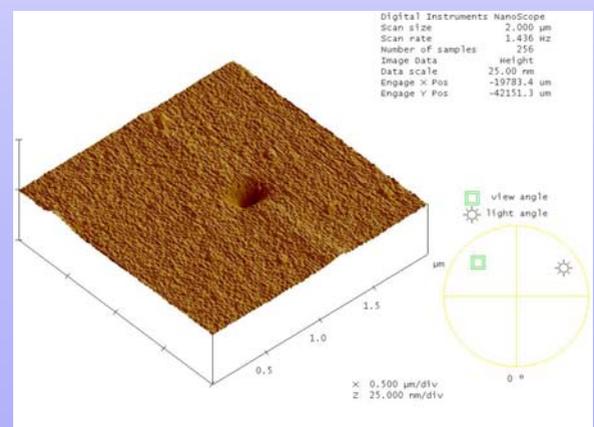
Future work will include fabrication of holes with varied sidewall angles by milling of multiple concentric features or by fabrication of varied shapes.



Dark field optical microscope image of the array of pits. There is 25 microns between each pit and they are smaller and shallower toward the top left



SEM image of a sample pit milled in the surface. This pit is about 100 nm wide.



AFM image of a sample pit milled in the surface. There are no noticeable added defects near the milled hole.