Direct-Write Lithography and Etch of Images by Dithering Process

T. Mittelbrun, F. S. Fernandez and G.L. Kim
Singh Center for Nanotechnology, University of Pennsylvania, Philadelphia, PA 19104
kimgyu@seas.upenn.edu

We demonstrate a pattern transfer process of images by conduction dithering. This work details the data preparation and fabrication of images into a SiO2 thin film using Heidelberg direct-write lithography and reactive ion etching (RIE). Images are dithered to improve the signal-to-noise ratio, then converted into 1-bit binary images. These dithered images were subjected to data preparation using the software BEAMER to assign a specific dose to each type of pixel for lithography. A dose test was conducted to determine the optimal laser power for this experiment. Ultimately, a 145 mW of laser power was used followed by partially etching the SiO_2 to create a unique color dynamic between areas of different thickness through light interference thin film. We find that a minimum pixel density is required to recreate the image in sufficient detail. For the 4.8 mm x 3.9 mm area that each image in this experiment was fabricated within and characterized with the optical microscope. The images with a pixel density of at least 0.05342 pixels/um^2 showed considerable resemblance between the etched and original photo. A comparison between inverted and non-inverted tone was studied to show the importance of tone consideration when choosing which pixels to expose or not expose. The tailoring of pattern transfer by dithering process provides a nanofabrication-based perspective on various applications where reverse engineering, circuit editing, education, and workforce development.