

Fabrication of an Optical Magnetic Mirror by E-Beam Writing

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Normal mirrors interact with light via the electric field in electromagnetic radiation, oscillating electrons in the metal coating layer of a mirror. In a magnetic mirror¹ the interaction occurs with the magnetic part of the electromagnetic field. The H-field oscillates electrons in sinusoidal shaped nanowires resulting in the emission of new photons as the electrons accelerate. This constitutes a different form of “reflection” as the light undergoes a 0-degree phase shift instead of the usual 180-degrees. E-beam writing and associated process are currently the only ones capable of fabricating these nanowires for use at visible wavelengths. High resolution Vistec EBP5000+ e-beam lithography tool was used to write the dense nanostructure patterns on active areas of 5 mm².

The fabrication process for the nano structure mirror design is as follows:

1. Thermal oxide wafers were coated with bilayer PMMA (150nm PMMA 495k followed by 150nm PMMA 950k) on the SUSS ACS200 wafer track.
2. Dense nano patterns were exposed by e-beam lithography on a 5mm² die (Fig 1 and Fig 2). Alignment marks were also written with e-beam for the next level of contact lithography.
3. After a short 2 minute descum process Ti/Au or Al layer was evaporated.
4. The wafer was immersed in Acetone for successful lift off. This step resulted in the nanowire patterns around the mirror with fiducials for next level of optical lithography defining the area for deposition or growth of high absorption coating.

Results will be presented on fabrication of prototype devices with varying configurations on alternate substrate material such as Spin on Glass (SOG) and AlMgF₂.

Reference: ¹ Optical Magnetic Mirrors A.S.Schwanecke et al. J Opt A: Pure Appl. Opt. **9** (2007) L1-L2

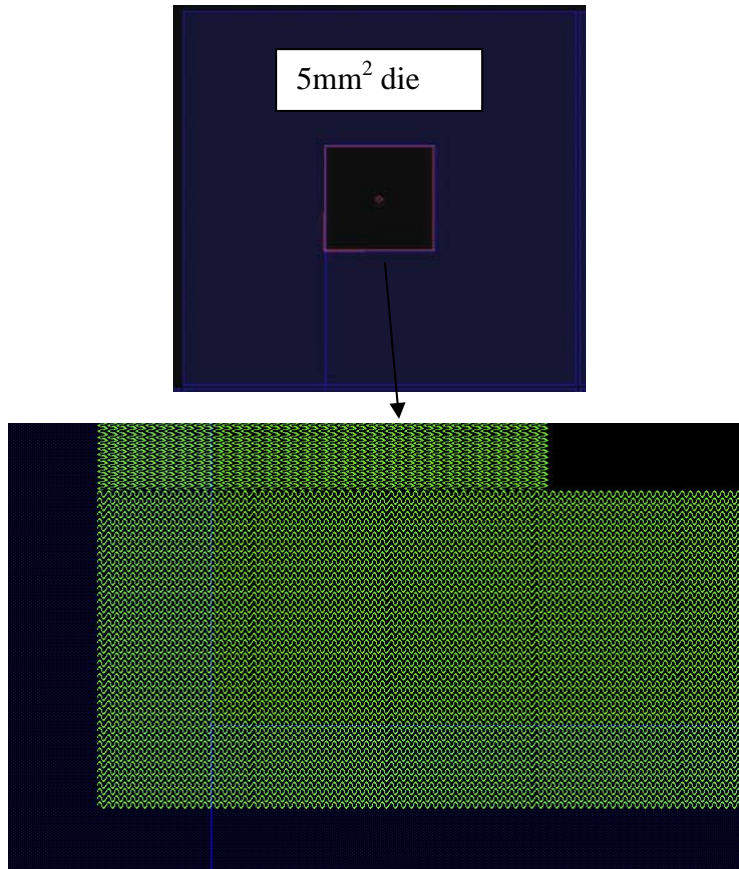


Figure 1: 5 mm² die shown above with nanowire design enlarged.

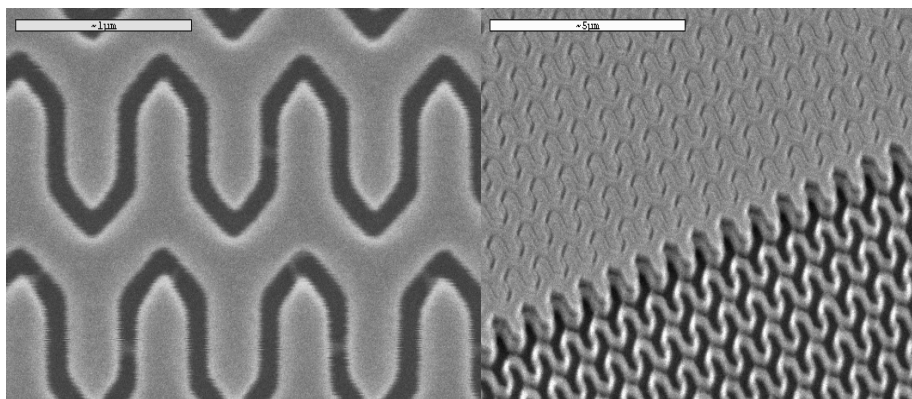


Figure 2: E-Beam exposure of nanopattern, metallization and successful lift off.