

Fabrication of large area negative index structures by Nanoimprint Lithography

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In this work we show large area fabrication of negative index structures by Nanoimprint Lithography (NIL).

NIMs are artificially structured materials, where the designed structures provide resonances for the electric and magnetic field such that negative refraction occurs. Usually NIMs for wavelengths smaller 10 μm are fabricated by e-beam lithography on small areas [1]. We report on large area fabrication of negative index structures like fishnet structures by NIL. NIL is an emerging technology for a fast and cost efficient replication of nanostructures and we show therefore the scalability of mass production of NIMs.

The quartz stamps (2.5 x 2.5 cm^2) containing fishnet structures were designed and fabricated at the Friedrich Schiller University, Germany. The stamp contains 4 fields (each 1 x 1 cm^2) with four different structure sizes ranging from 1200 nm period to 300 nm period in y-direction and 1000 nm to 250 nm in x-direction. The quartz stamp was treated with the anti sticking layer BGL-GZ-83. For imprinting glass substrates were used with stacked layers of 2 nm Ti, 12 nm Au, 25 nm SiO_2 , 2 nm Ti and 12 nm Au on top. To increase the adhesion of mr-UVCur06 on gold the adhesion promoter TI-Prime was used. First the residual layer, the first gold layer and the SiO_2 layer were etched with the same etching recipe: 25 mTorr CF_4 (50 sccm) and 83W. The gold layer was etched mechanically whereas the SiO_2 layer was etched chemically by the CF_4 . Afterwards the remaining bottom gold layer was etched using a wet chemical etching. The residual Ti layer was removed with 0.5 min CF_4 etching.

RCWA simulations and optical measurements using ellipsometry and reflection and transmission measurements are ongoing to measure the permittivity and permeability of the fishnet structures. It is also planned to stack several aligned fishnet layers similar to the process in ref. 2. providing large enough vertical distances, such that no cross-coupling can occur.

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References

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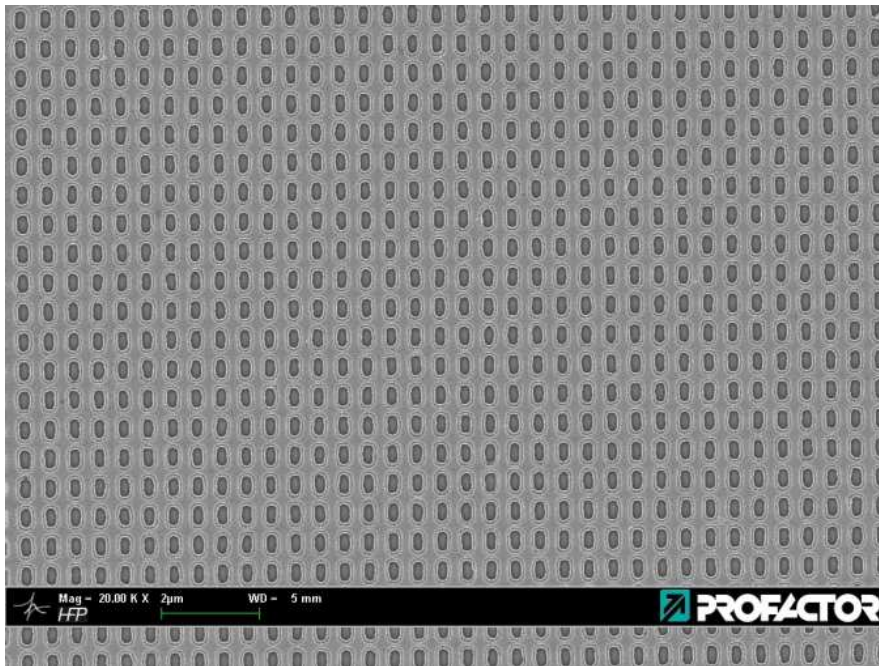
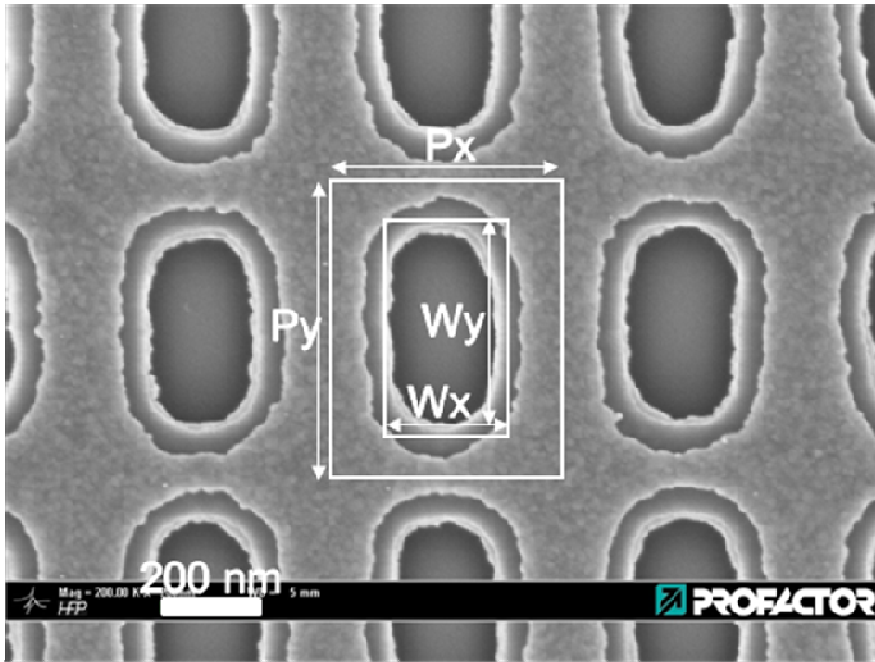


Fig 1: SEM images of the fishnet structures made by NIL with a period of P_x/P_y 500/600 nm, W_x/W_y about 200/400 nm on large area (1x1 cm²).