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Development of All Dry Nanoimprint Lift-Off Process for Growth of NWs

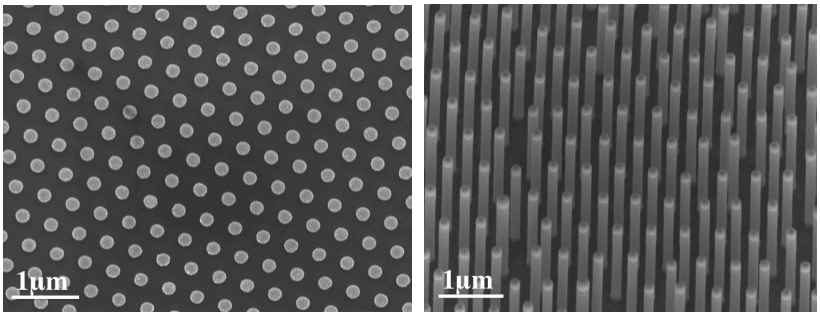
There are two methods for fabrication of nanostructures: bottom-up and top-down. In this work IPS-STU nanoimprint process that is a top-down approach, is applied to pattern the substrate. A dry etching process is developed to realize a desired undercut in the resist for the lift-off. Gold particles are produced on the surface, which could be used to grow InP nanowires (NWs) using epitaxial techniques.

Nanoimprint lithography (NIL) is one of the lithographic methods. In this process the features of a Ni stamp as a master stamp are transferred into the underlying substrate mechanically. This technique leads to high throughput and high resolution.

There are two approaches to a make a desired undercut in the resist. One approach is a wet etching process, which uses O_2 plasma and MF319 solvent as etching developer to create undercut in the resist. Wet etching process does not affect the size of holes. However adhesion and difficulties to control the process manually are the main disadvantages. Another approach employs the dry etching process. This process uses O_2 plasma to make undercut in the resist, although having the disadvantage of affecting the size of holes.

By performing epitaxial methods such as Metal-Organic Vapor Phase Epitaxy that is a bottom-up approach, NWs are grown. NWs are 1D structures with a diameter of few nanometers and a length of several micrometers. Due to their optical and electrical properties they are used in devices such as light-emitting diodes and transistors.

The results indicated that by optimizing RIE-O_2 plasma parameters the desired undercuts in the resist are realized. The controlled diameter of the gold particles could be obtained and also, dry etching works well to grow InP NWs from gold particles shown in Fig. 1.



(a) (b)

Figure 1: (a) Gold particles produced on the surface directly after lift-off, (b) Grown of InP NWs by using a dry etching process.

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