# Fabrication of Photonic Components by Nanoimprint Technology within ePIXnet

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ePIXnet is a Network of Excellence with a focus on photonic integrated circuits. Its objective is to serve the academic and industrial research community by building a world-class research infrastructure and to make it accessible. This is done through the creation of technology platforms and Joint Research Activities (JRAs). The JRA-Nil is concerned with the integration of Nanoimprint Lithography into the fabrication process also using its unique advantages of 3D-replication for photonic applications. The aim is to design, fabricate, and push the performance limits for passive SOI structures such as low-loss photonic crystal (PhC) waveguides and photonic wire (PW) structures, slow-light structures, high-Q cavities, and wavelength selective components with very low crosstalk.

One application field of the JRA-Nil encompasses basic photonic elements including waveguides, resonator structures, couplers and splitters. These elements are fabricated by Nanoimprint in order to reduce fabrication costs and time. The elements are fabricated on Si- and optional on InP-substrates. Goal is to achieve absorption losses and optical quality factors in the same range as elements fabricated by SOTA-Ebeam processing. These activities form the base for the fabrication of more complex devices designed in other JRAs. A second application field deals with the manufacturing of first order grating structures for widely tuneable InP-based DBR lasers. Here, two types of gratings need up to 600µm long are realised for the digital supermode (DS)-DBR; a chirped (>50nm) grating at the front end and a rear comb reflector containing multiple pi-phase-shifts. Another major point of interest concerns elements which are not trivially manufactured by standard procedures. Nanoimprint offers several unique opportunities to manufacture 3D-pattern with just one lithography step. One manufacturing technique, that allows to replace two standard lithography steps with only one imprint step, is used for wafer scale fabrication for integration of active and passive polymer optics - polymer DFB lasers and waveguides. These polymer dye DFB lasers are fabricated by combined nanoimprint and photolithography (CNP). The CNP fabrication relies on an UV transparent stamp with nm sized protrusions and an integrated metal shadow mask. In the CNP process, a combined UV mask and Nanoimprint stamp is embossed into the resist, which is softened by heating, and UV exposed.

The photonic components in figure 1) have been imprinted using a UV-Nanoimprint Lithography (UV-Nil) process; in figure 2) the schematic setup of a polymeric DFB-laser fabricated using a combined nanoimprint and photolithography (CNP) process and its output wavelength dependency on the used grating period are shown.

In this poster-contribution the partners of the JRA-Nil like to present a spectrum of nanoimprint fabrication methods for different photonic applications and the measurement results on exemplary SOTA-components.

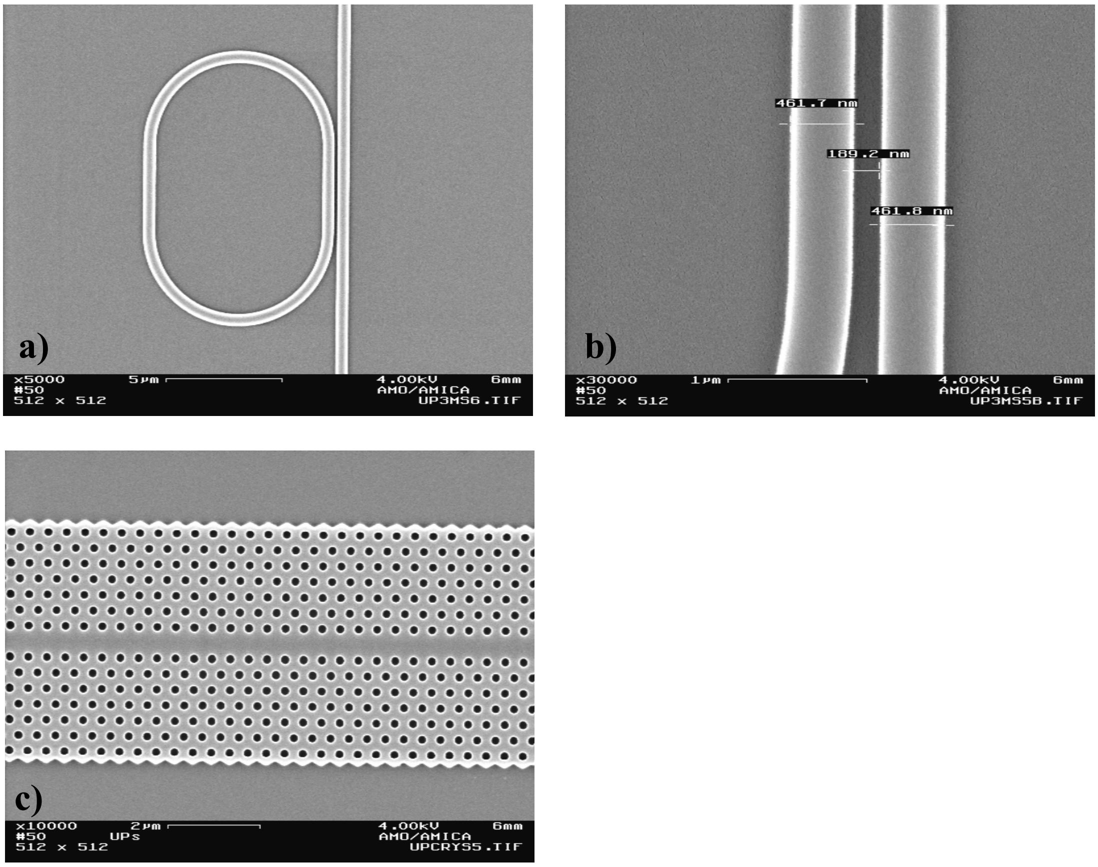


**Figure 1:** Imprinted photonic structures; a) ring resonator, b) close-up on gap between resonator ring and waveguide and c) imprinted photonic crystal

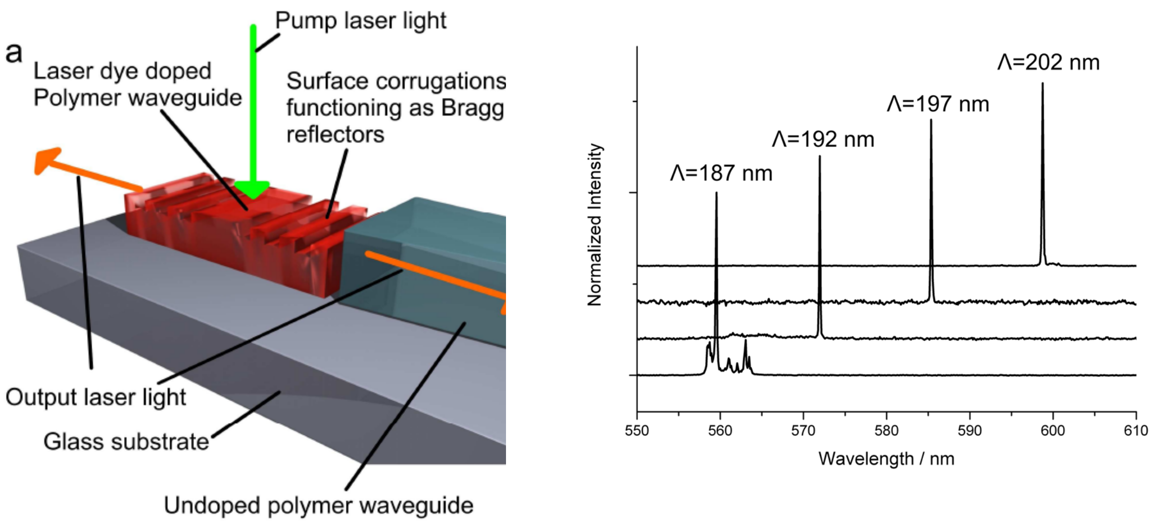


**Figure 2:** Schematic of polymer DFB-Laser fabricated by combined nanoimprint and photolithography (CNP) and measurement of change in output wavelength of DFB-laser in dependency of the imprinted grating period