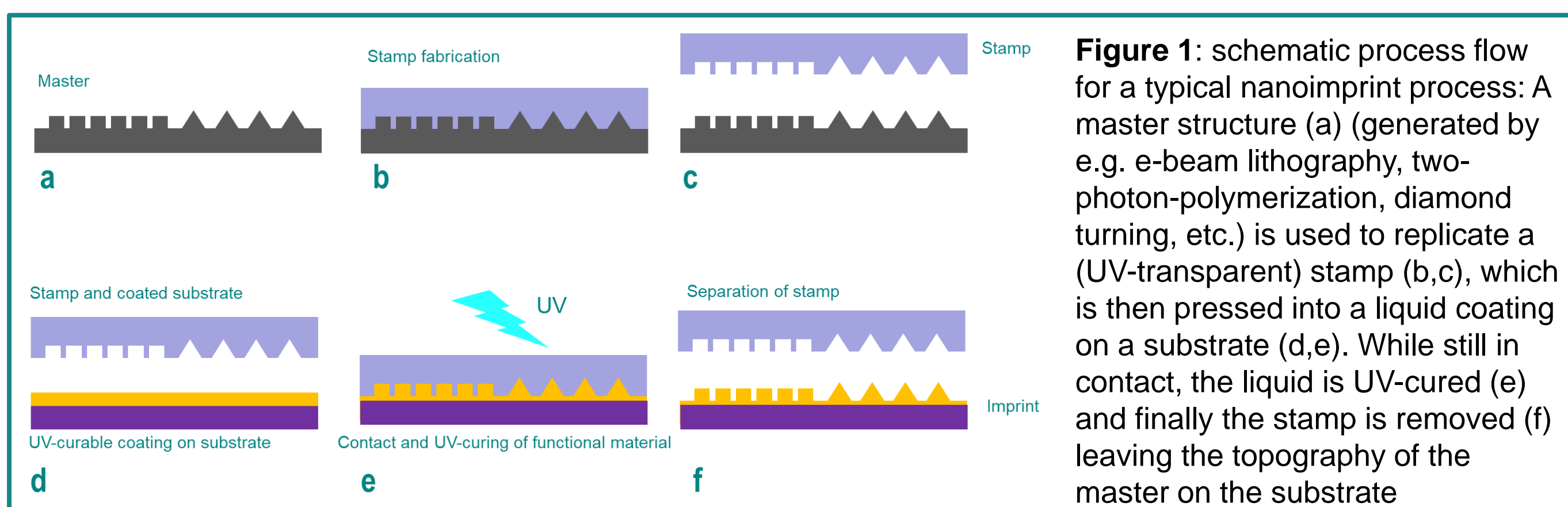


# Nanoimprint Lithography

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## Introduction

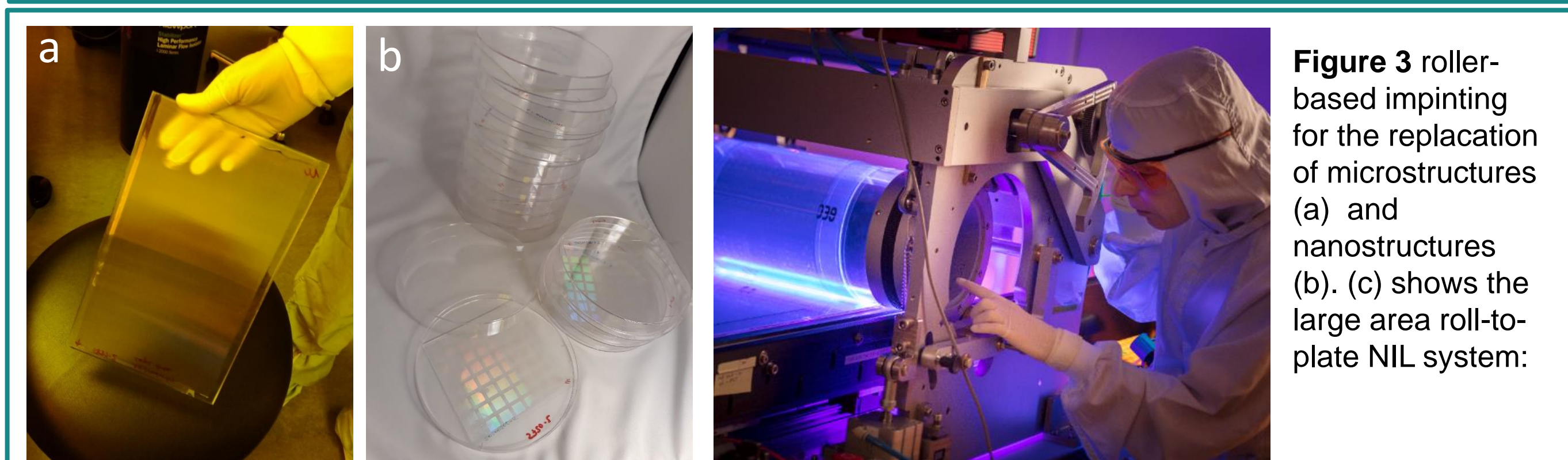
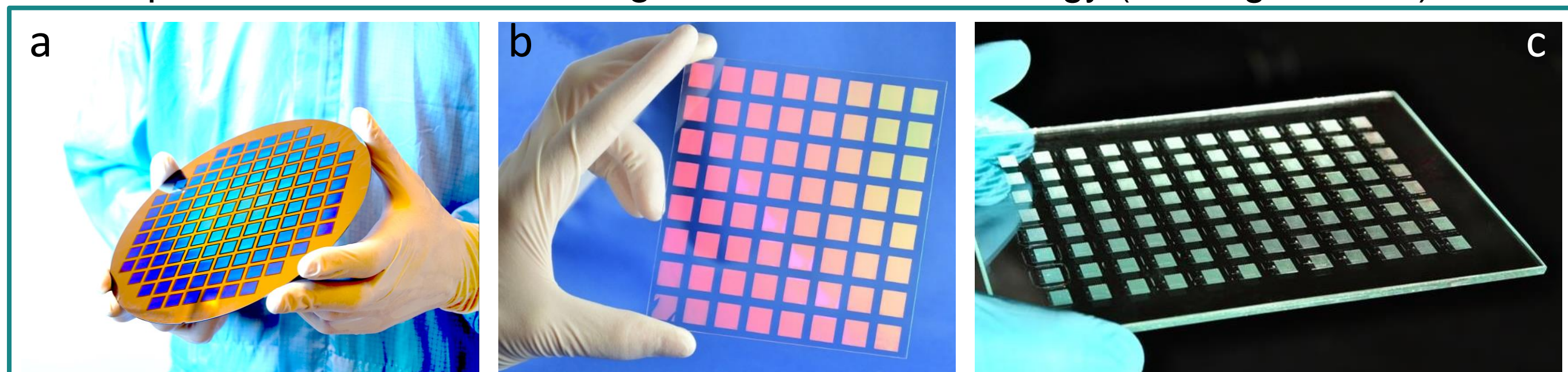
Nanoimprint Lithography is a replication technology for micro- and nanostructures. It is highly versatile as far as the kind of structures is concerned (10nm – 750µm) as well as in terms of applications, which range from live sciences to metaoptics. Figure 1 gives a brief overview of the basic process flow.



A distinction can be made depending on what happens after the imprinting step: Either the imprinted structures are already the desired device (e.g. a microlens, a grating) or the patterned resist is used as an etch mask for pattern transfer into the underlying substrate. At PROFACTOR we have established nanoimprint processes and tools which cover a broad range of applications ranging from micro-optics to life sciences as well as from plasmonics to bionics. Our processes range from small scale manual testing to large area roll-to-plate nanoimprinting.

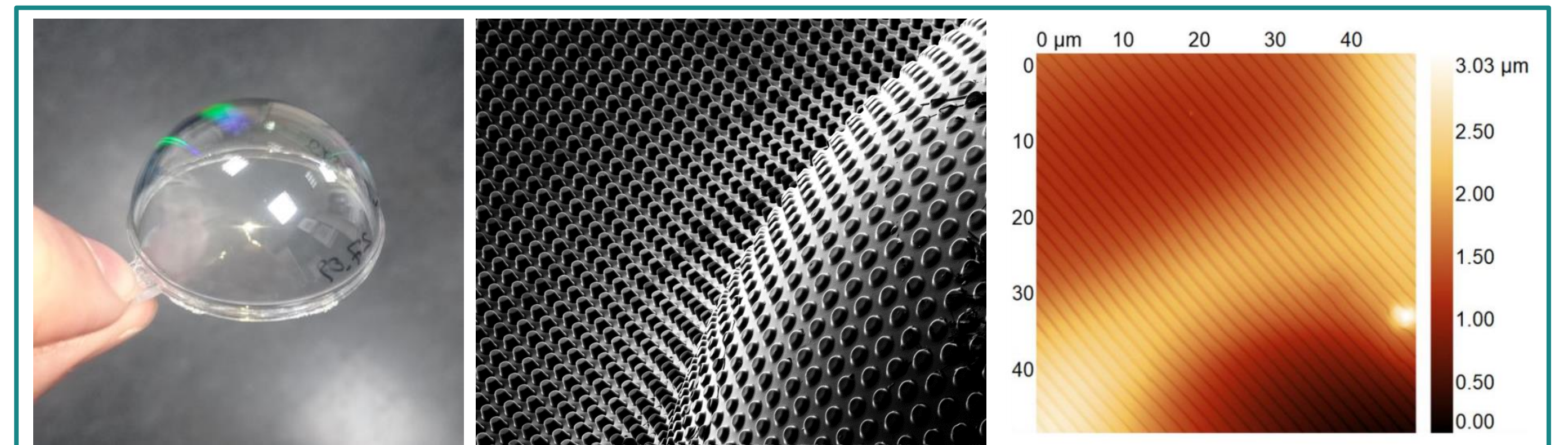
## Examples

We use commercial tools as well as self made equipment. These tools allow us to be very flexible in process development and ideally address our customers' and project partners' requests. There are two types of step&repeat NIL tools, one for nanoscale feature nanoimprinting on pre-coated substrates and one for microscale feature replication with dedicated material dispensing for each imprinting step (see Figure 2). In addition to directly patterning the substrates, our step and repeat tools also are used to create masters for the fabrication of imprinting plates for roll-to-plate nanoimprinting. For large area imprinting (30x60cm<sup>2</sup>) we have an industrial R2P nanoimprint tool built on Stensborg's HoloPrint® technology (see Figure 3 ab).

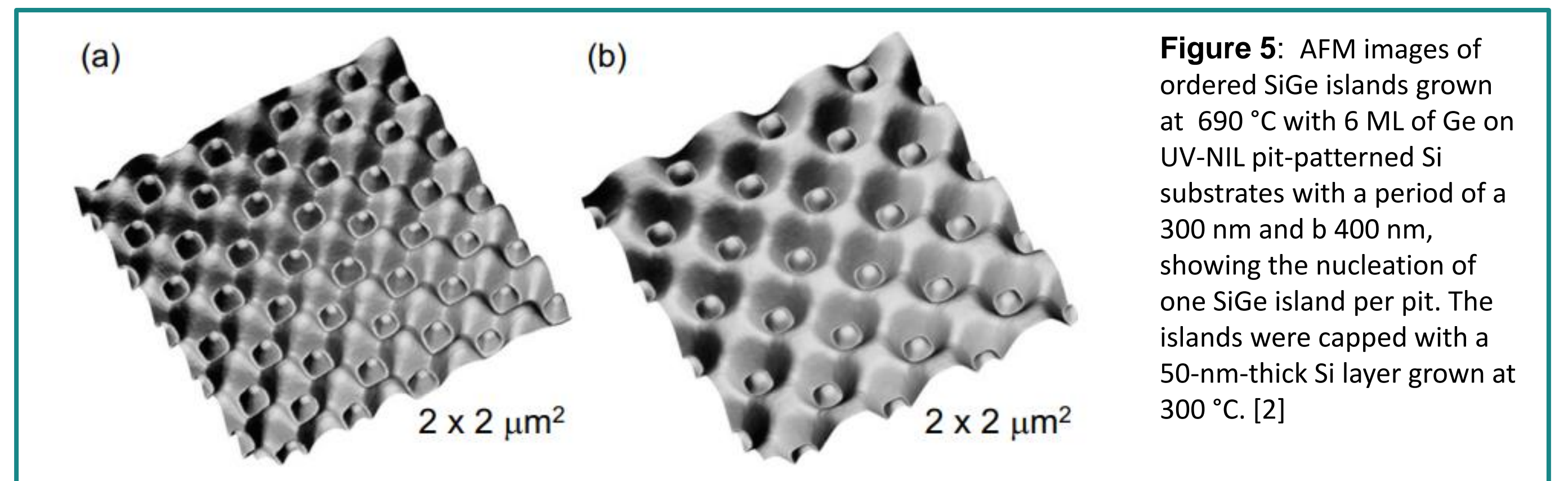


In addition to nanoimprinting on flat substrates we have also a tool for nanoimprinting on arbitrarily curved substrates. The curvature can be microscopic as well as macroscopic, creating for example the opportunity to combine two different optical functionalities into one structure. (Figure 4)

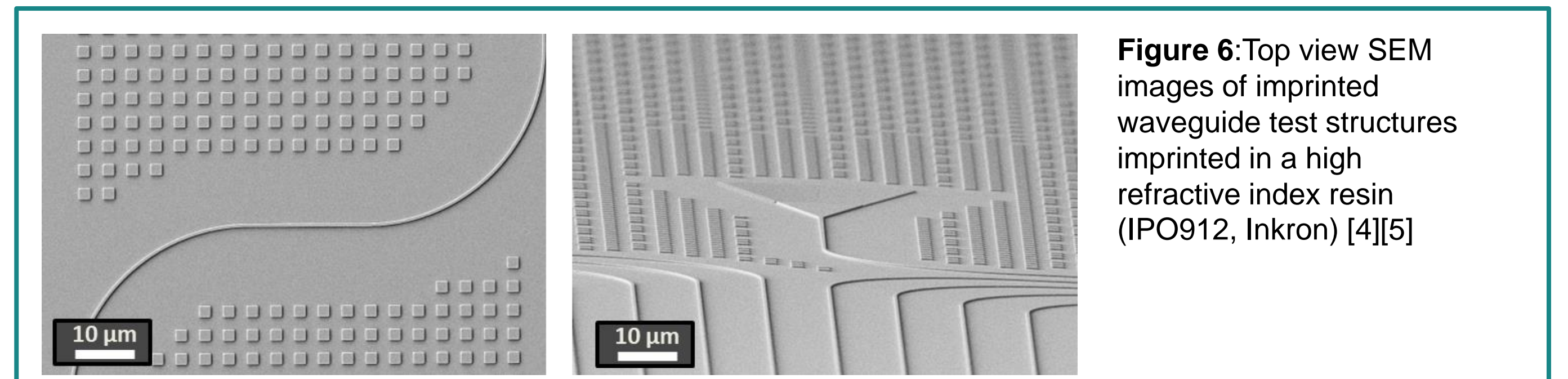
An example for a nanoimprint process with subsequent pattern transfer is given in Figure 5, which shows SiGe quantum dots grown on a prepatterned substrate.



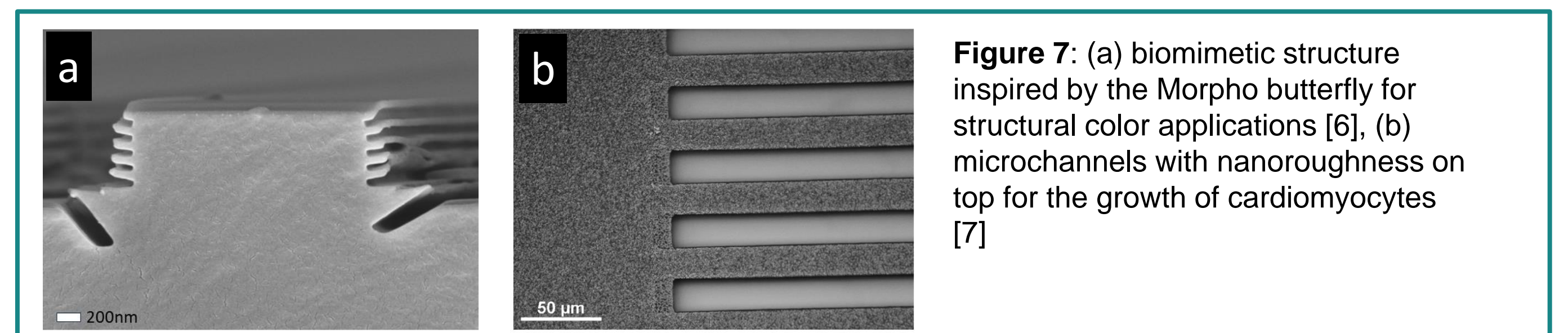
**Figure 4:** Nanoimprinting on non-flat surfaces. (a): a moth eye anti reflection pattern on a polymer hemisphere, (b): a polymer pillar pattern on a 150µm diameter glass sphere and (c): a grating structure imprinted on top of a free-form diffusor [1]



An interesting option for nanoimprinting is however also the use of functional permanent materials, which exhibit an application-specific refractive index or are biocompatible for cell growth experiments or implants [3]. Figure 6 shows an example of waveguides fabricated for a LiDAR application.



Finally, the capability of nanoimprinting to replicate complex structures in a single processing step is a feature that stands out among high throughput lithography techniques. (see Figure 7)



In summary, nanoimprint lithography is a very versatile technique with a broad application potential. We would like to contribute with our NIL technologies to address the needs of the QUANTUM AUSTRIA community.

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