inseto	**Imprint Photolithography**	
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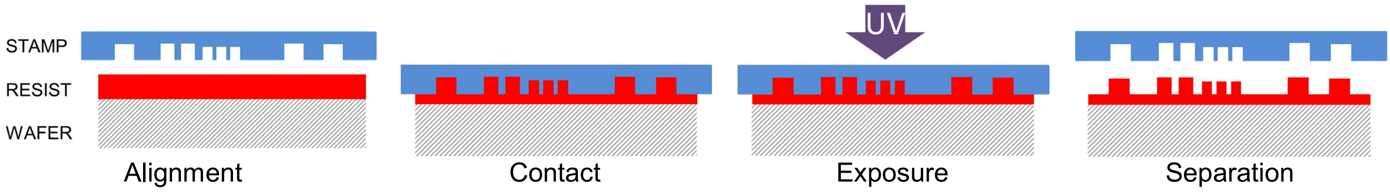
- SCOPE: Overview of Micro & Nano Imprint Photolithography

Imprint photolithography is a key technology for many emerging applications such as micro-optics, augmented reality, MEMS and optoelectronic sensors; but what is it and how does it work?

Photolithography, be that optical, electron-beam or imprint, is the process of transferring a pattern from one object onto another. Electron-beam and optical photolithography are used to transfer a two-dimensional pattern either from a photomask or a computer program onto a substrate. Imprint photolithography is concerned with the transfer of three-dimensional patterns and structures to a substrate.

A typical imprint photolithography process consists of the following steps:

- The wafer is coated with an imprint resist and aligned with a stamp
- The wafer and stamp are brought into contact and the resist fills the cavities in the stamp.
- The resist is solidified through UV cross linking or an external thermal source
- The stamp is removed and the resist is left imprinted with the desired pattern.



Crucial to the imprint process is the fidelity of the stamp containing the 3D pattern. Typically, this design will have submicron features that need to be reproduced to a high tolerance. The process for producing these master stamps can be lengthy and expensive, so precise control of the imprint and removal are required to ensure no damage to the stamp. Often, to protect the master copy of the pattern, the stamp used in day-to-day fabrication is an imprinted replica. This stamp will do many hundreds of imprints before it must be replaced, as the integrity of the surface slowly degrades and the yield of the devices produced decreases.

The limitations of imprint photolithography are three-fold. The first, as addressed above, is that the imprint will only be as good as the quality of the stamp. As such, much research and time is spent by leading manufacturers to improve the fidelity of stamp replication and the subsequent coating of the stamp with anti-sticking layers.

The second limitation is in the imprint and exposure process, again equipment manufacturers are constantly innovating and bringing the alignment accuracy to <1 µm for patterns that can be microscale or nanoscale. Leading manufacturers have now developed techniques that allow the same technology to be used to imprint microscale features i.e. features from the millimetre level down to the micron level and to imprint features less than 100 nm. Previously, this wide process range would have required multiple equipment installations.

The third and final source of limitation is in the resists used to imprint with. These must be able to flow into the cavities of the stamp, be curable either by heat or light and have fast curing times, so that high device throughput is possible as processes scale up to manufacture. The resist materials must also be able to reproduce the high aspect ratios required of them, whilst possessing precise other physical properties, such as refractive index or electrical conductivity. As with the tool requirements, the chemical manufacturers are constantly improving and producing new materials to push this field forwards and enable scalable imprint photolithography to be a reality in a production environment.

Imprint photolithography is a mature technology suitable for fabricating three dimensional structures, where definition and precision are key and can be deployed whether the features are of mm, µm or nm scale.