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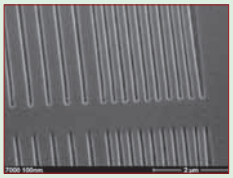
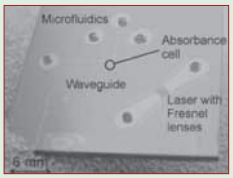
micro resist technology

Nanoimprint Materials News

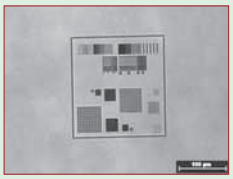
***micro resist technolgy* has developed several polymers for thermal nanoimprint lithography (hot embossing) as well as for UV-based nanoimprint lithography allowing the customer to choose advanced materials fitting to their specific processes. All these nanoimprint polymers are provided as reasy-to-use solutions customised for specified film thickness.**



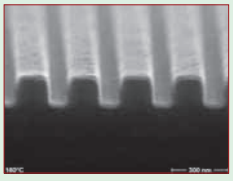
Lines imprinted in mr-I 7000E, 100 nm trenches, 300 nm and 500 nm pitch, residual layer thickness < 10 nm



Complete lab-on-a-chip device for absorption measurements, all components imprinted in one layer of mr-I T85 (Courtesy of MIC / TU Denmark)



Uniform filling of patterns with different size imprinted in mr-I 9000E (100 nm to 2 µm)



200 nm lines, 100 nm trenches imprinted in mr-I 9000M after annealing to 220 °C -> thermally stable patterns, no reflow!

Thermoplastic polymers for thermal nanoimprint lithography

✓ **mr-I 7000E (T_g= 60 °C) and mr-I 8000E (T_g= 115 °C) – Etch mask for pattern transfer**

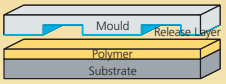
The excellent imprint behaviour of these materials enables imprinting processes with low imprint pressure, short cycle time and very low residual layer thickness. Further unique features are excellent film quality of the spin-coated films, attainable smallest feature size of at least 50 nm and plasma etch resistance superior to PMMA. mr-I 7000E and mr-I 8000E differ in their imprint temperature due to different glass transition temperature T_g so that the user can choose the specific polymer that meets best the thermal requirements.

✓ **mr-I T85 (T_g= 80 °C) – Permanent applications in lab-on-a-chip, microfluidics and micro-optical components**

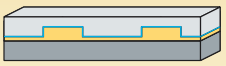
The main features of this unpolar thermoplastic are excellent UV and optical transparency, high chemical stability, high resistance to acids, bases, and polar solvents, beneficial flow behaviour allowing low imprint pressure, and high plasma etch resistance. Feature sizes can be imprinted ranging from sub-100 nm to 100 µm.

Process

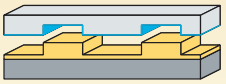
Spin coating and prebake



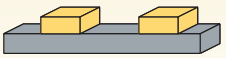
Nanoimprint @ $T > T_g$



Mould is detached @ $T < T_g$



Anisotropic plasma etch



Thermoplastic Polymers

Thermosetting polymers for nanoimprint lithography

✓ **mr-I 9000E – Etch mask for pattern transfer**

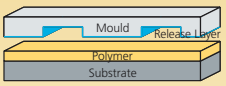
This thermosetting polymer combines several outstanding characteristics ideal for the application in pattern transfer processes: low imprint temperature, short cycle time due to nearly isothermal imprint process, and very low residual layer thickness. Further features are excellent film quality, attainable smallest feature size at least 50 nm and plasma etch resistance superior to PMMA.

✓ **mr-I 9000M – Permanent applications – Isothermal imprint process**

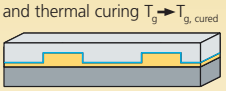
The thermoset mr-I 9000M was designed for permanent applications with high thermal stability requirements. After thermal curing during the imprint the patterns are stable up to 260 °C.
The mould release at the imprint temperature enables an isothermal imprint process.
The beneficial flow behaviour allows simultaneous imprinting of nano and micropatterns.

Process

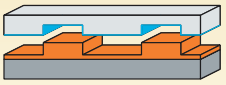
Spin coating and prebake



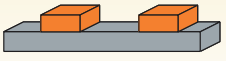
Nanoimprint @ $T > T_g$ and thermal curing $T_g \rightarrow T_{g,\,cured}$



Mould is detached @ $T < T_{g,\,cured}$



Residual polymer layer is removed by anisotropic plasma etching



Thermosetting Polymers

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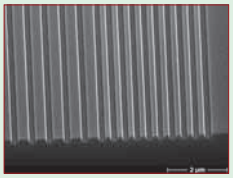
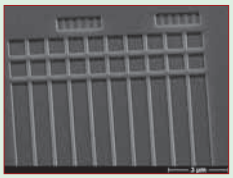


200 nm trenches imprinted in mr-NIL 6000



200 nm lines imprinted in mr-NIL 6000

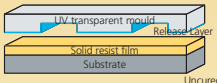
Photochemically curing polymer for thermal nanoimprint lithography

✓ **mr-NIL 6000 (T_g= 40 °C) – Isothermal imprint process**

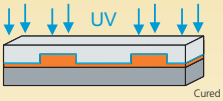
mr-NIL 6000 is a photochemically curing polymer for thermal nanoimprint lithography. The polymer forms solid films after spin-coating and prebake. Its low glass transition temperature (T_g 40 °C) enables imprinting at moderate temperatures. Curing of the polymer is beneficially done during the imprint process by UV flood exposure and post exposure bake (PEB) in the machine at the imprint temperature. This gives the thermal stability required for subsequent processing. Optimal are imprinters combining thermal imprinting and UV exposure. The increase in T_g of the resist during curing in the imprinter allows a mould release at the imprint temperature and hence an isothermal imprint process. Features of excellent quality and minimum residual layer thickness < 10 nm are obtained. The polymer exhibits high wet and dry etch resistance. mr-NIL 6000 is well suited for both pattern transfer and permanent applications e.g. in micro-fluidics and photonic crystals.

Process

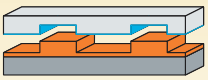
Spin coating and prebake



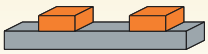
Nanoimprint @ $T_i > T_g$,
UV flood exposure and
post exposure bake



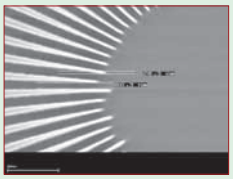
Mould detached @ T_i



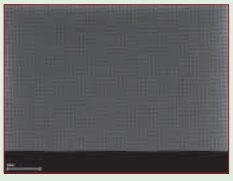
Anisotropic plasma etch



Photochemically Curing Polymer



Imprinted lines in mr-UVCur06, sub-30 nm resolution (Courtesy of AMO, Germany)



Large-area imprint, 800 nm squares, 1200 nm pitch (Courtesy of Profactor, Austria)

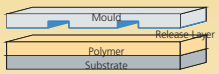
Fast curing polymer for UV-based nanoimprint lithography

✓ **mr-UVCur06 – Fast curing polymer for UV-based nanoimprint lithography**
– Etch mask for pattern transfer

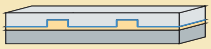
This UV-NIL polymer has been designed for full-wafer processing. Spin-coating gives 150 – 500 nm films with excellent quality and uniformity. The low viscosity of mr-UVCur06 enables fast filling of the mould cavities and very thin residual layers. Curing at low UV doses reduces the cycle times to a minimum. Pattern sizes from sub-30 nm to several tens of microns can be simultaneously imprinted with a high pattern transfer fidelity.

Process

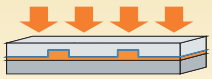
Spin coating and prebake



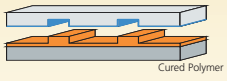
Imprint at room temperature



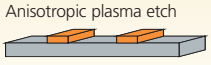
UV exposure



Mould release



Anisotropic plasma etch



UV-Curable Polymer