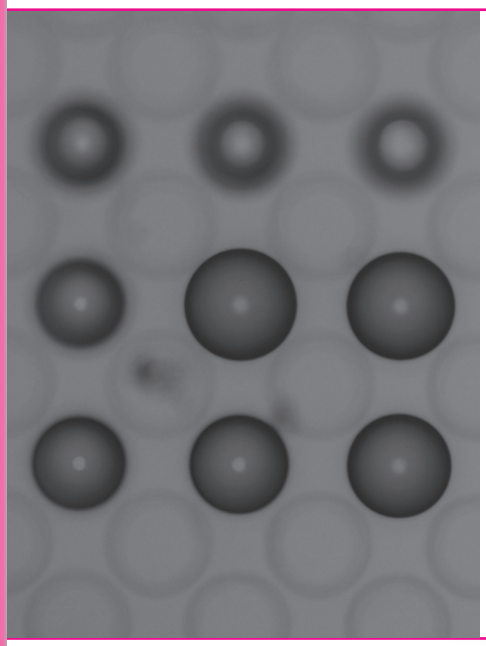
micro resist technology

Functional Materials for Inkjet Printing



- **InkOrmo**
- **InkEpo**
- **mr-UVCur26SF**

Broad range of applications

- Optical components (transparency and stability)
- Packaging (stability)
- Nano Imprint Lithography (low residual layer thickness)
- Etch mask for plasma etching (stability)

Unique features of our materials

- Compatible with commercial inkjet printing equipment
- Tailored for stable drop generation
- UV-curable formulations

- Made in Germany -

micro resist technology GmbH
Gesellschaft für chemische Materialien spezieller Photoresistsysteme mbH

Köpenicker Str. 325
12555 Berlin
GERMANY

phone +49 30 64 16 70 100
fax +49 30 64 16 70 200
mail sales@microresist.de
info www.microresist.com

August 2018

Product overview

Inks[1]	InkOrmo* series	InkEpo* series	mr-UVCur26SF
Type of material	Optical polymer	Optical polymer	Resist

Properties before UV-curing

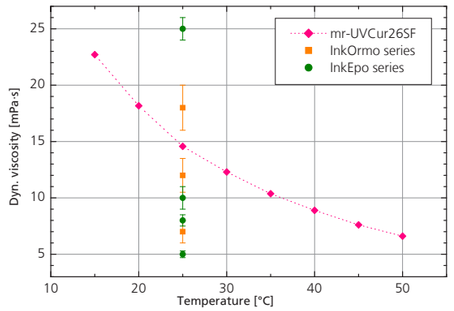
Viscosity at room temperature (25 °C) [mPa·s]	**7.0 ± 1.0** **12 ± 1.5** **18 ± 2**	**5.0 ± 0.3** **8.0 ± 0.5** **12 ± 1** **25 ± 1**	**15 ± 2**
Solvent free	No	No	Yes
Photo curing spectral sensitivity [nm]	300 – 410	300 – 390	365 – 405[2]
Oxygen sensitive curing	No	No	Yes[3]

Properties after UV-curing

RI (at 589 nm) after curing	1.517 – 1.520[4]	1.555[4]	1.518
CTE (20 – 100 °C) [ppm/K]	60	~ 50	n/a
dn/dT [10^{-4}/K]	-2.0	-0.7	TBD
Young Modulus [GPa]	~ 1	~ 2	n/a
Hardness (indentation) [MPa]	68 ± 1	-	n/a
Water absorption	< 0.5%	< 0.5%	TBD

[1] Our inks are compatible and have been tested on several inkjet printing tools. List available upon request [2] Hg bulb lamp or monochromatic LED [3] Formation of an inhibition layer when UV-cured in presence of oxygen [4] Depends on hard-bake conditions

Viscosity

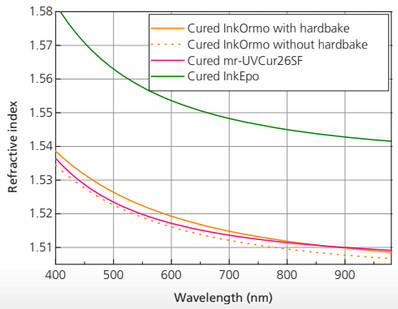


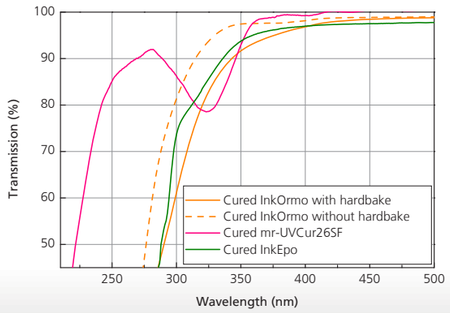
Specific properties

InkOrmo* and InkEpo*
- • Permanent applications
- • Optimized for optical applications
- • High thermal stability up to 300 °C (short term), 270 °C (long term)
- • High physical and chemical stability
- • Excellent mechanical properties

mr-UVCur26SF
- Solvent-free ink
- Compatible with NIL** process
- Optimized for easy demolding after NIL
- Excellent plasma etch resistance
- No evaporation of formulation components

Optical properties



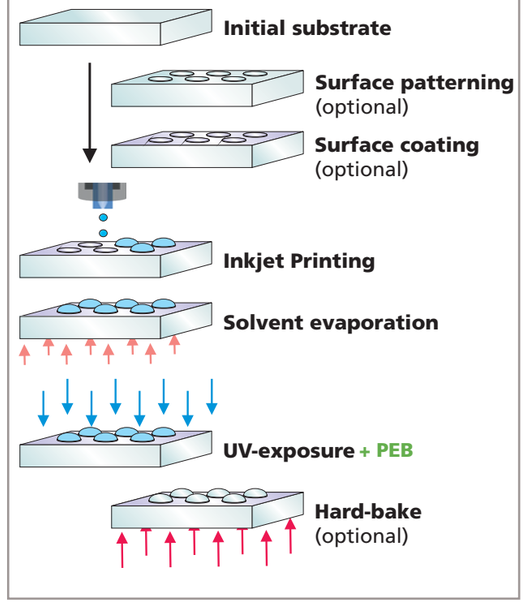


[1] The transmission is given for a thickness of 20 µm for InkOrmo, and a thickness of 1 µm for InkEpo and mr-UVCur26SF

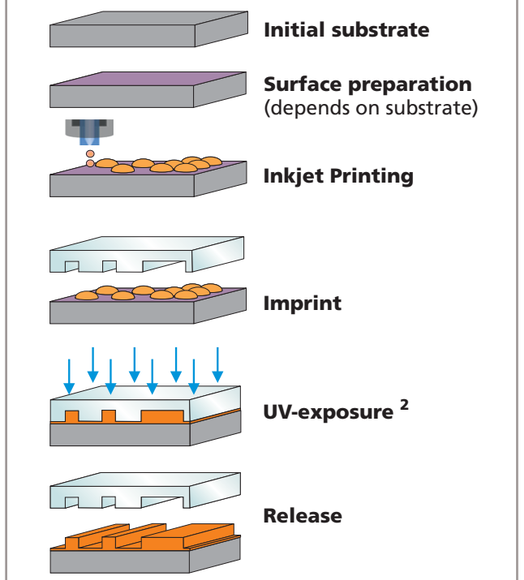
*Inkjetable optical polymers: EP 2 159 040 B1 „Micro optical articles, process for their production and uses"
**NIL stands for Nano Imprint Lithography

Processing examples

Example for microlens fabrication
InkOrmo and InkEpo



Example for NIL
mr-UVCur26SF



[1] The solvent evaporation step can be done with or without heating depending on process constraints [2] Either the substrate or the stamp needs to be transparent in the range of 365 – 405 nm

Substrate preparation

Adhesion
- Adhesion improved by the use of an adhesion promoter

InkOrmo - OrmoPrime®08 **InkEpo** - not required **mr-UVCur26SF** - mr-APS1

Surface energy modification
- The profile of the printed droplet can be controlled by modifying the substrate surface energy

InkOrmo & InkEpo - Allows to reach a higher / lower profile **mr-UVCur26SF** - Allows to increase the volume deposited / surface area for high-aspect-ratio NIL cavities

Surface pre-pattern
- Possible to print on substrates involving topography

InkOrmo & InkEpo - Topography can be specifically designed to confine InkOrmo onto desired locations

Process highlights and possible continuations

- Process compatible to non-flat as well as curved substrates and roll-to-roll (R2R)
- High compatibility to processes leading to high throughput and monolithic components

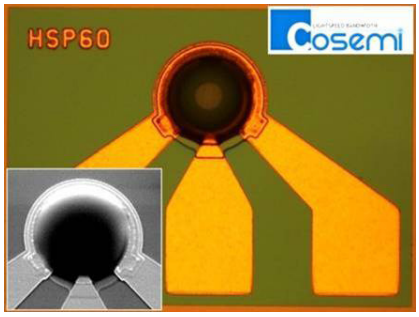
Suggested applications

InkOrmo & InkEpo
- Microlenses (single or arrays)
- Optical waveguides
- Optical couplers and connectors
- Diffractive optical elements
- Microfluidic systems

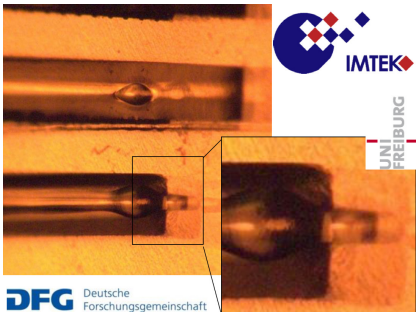
mr-UVCur26SF
- Step & Repeat NIL processes
- Large-area nanostructuring of flexible substrates
- Continuous R2R photo-NIL processes
- High volume manufacturing on flexible substrates of:
  - Antireflective coatings
  - (Super)Hydrophobic patterns
  - Wire-grid polarizers

Application examples

InkOrmo

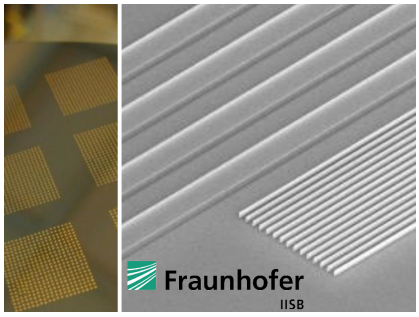


InkOrmo microlens printed on pre-patterned substrate, diameter of 100 µm (Printed at EPFL, Courtesy of Cosemi Technologies Inc., USA)



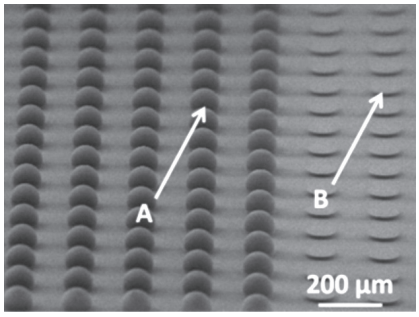
Inkjet-printed waveguide with 100 µm core and 300 µm cladding.
(Courtesy of IMTEK, Germany, 2)

mr-UVCur26SF

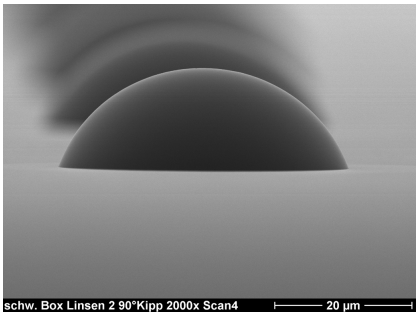


Left: Inkjet dispensed droplets. Right: subsequent imprinted submicrometer lines.
(Courtesy of Fraunhofer IISB, Germany, 5)

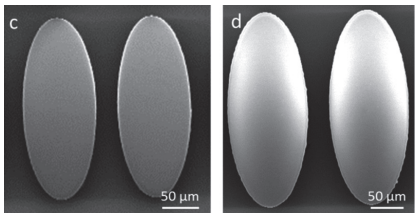
InkEpo



Array of InkEpo microlenses on 100 µm wide Si platforms (A) lenses on a platform, (B) empty platforms. (Courtesy of EPFL, Switzerland)



SEM pictures of cured InkEpo lens with Ø 45 µm, 10 drops per lenses on surface-treated glass slides. (Courtesy of EPFL, Switzerland)

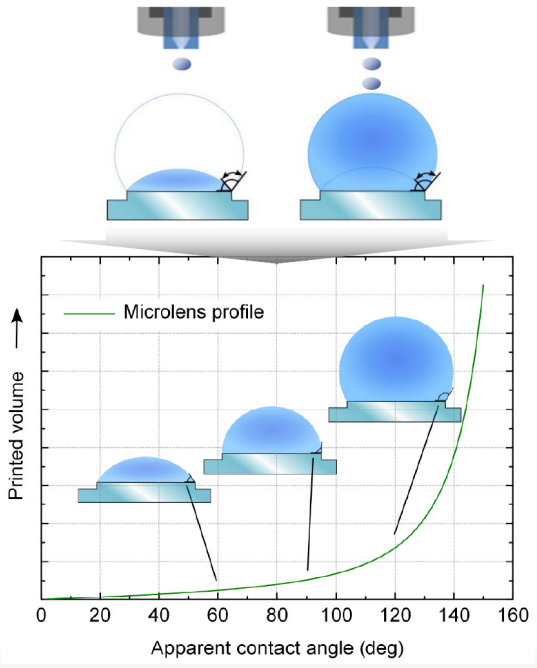


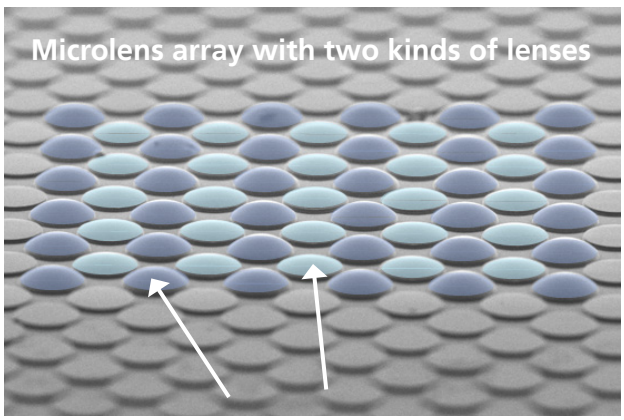
SEM images of (c) SU-8 platforms and (d) the corresponding lenses after performing the IJP of the InkEpo onto the platforms.
(Courtesy of EPFL, Switzerland)

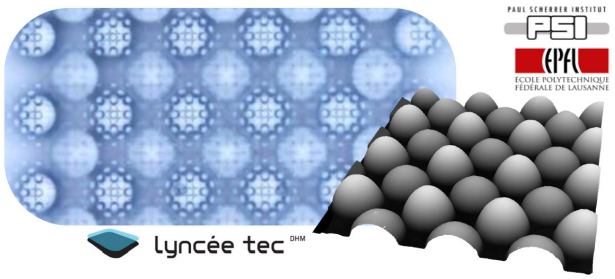
Application note

InkOrmo microlenses with specific profile by confining the microlens footprint

- Footprint topography or chemically confined
- Direct printing of final microlenses
- Specified and controlled lens profile







InkOrmo microlens with different optical characteristics
(Cooperation with EPFL, PSI and Lyncée Tec, Switzerland)