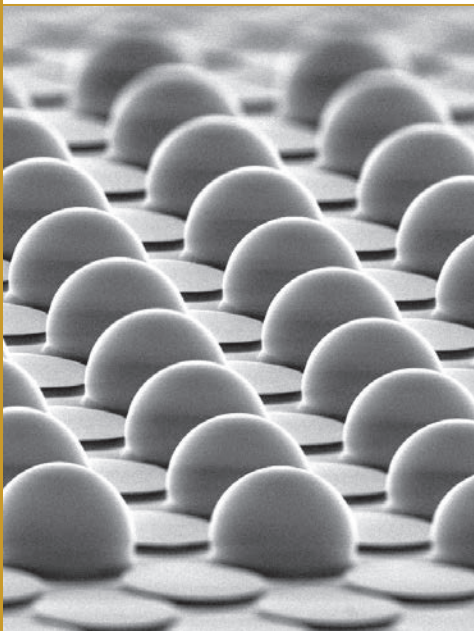


UV-Curable Hybrid Polymers for Micro Optical Components



- OrmoComp®
- InkOrmo
- OrmoClear®
- OrmoClear®10
- OrmoClear®30
- OrmoCore
- OrmoClad
- OrmoStamp®

Unique features

- Excellent transparency
- Excellent mechanical properties
- High chemical and physical stability
- Excellent replication fidelity
- Ready-to-use solutions

- Made in Germany -



micro resist technology GmbH

Gesellschaft für chemische Materialien spezieller Photoresistsysteme mbH

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12555 Berlin
GERMANY

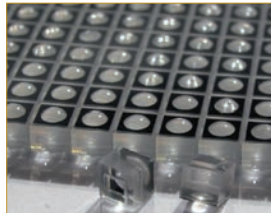
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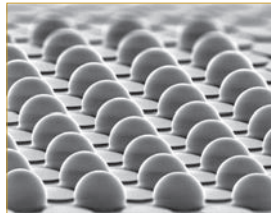
Product Overview

Material Specifications	OrmoComp®	InkOrmo	OrmoStamp®	OrmoCore	OrmoClad	OrmoClear®	OrmoClear®10	OrmoClear®30
Liquid material before patterning process								
Solvent-free	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Viscosity [Pa·s]	2.0 ± 0.5	*	0.4 ± 0.2	2.9 ± 0.4	2.5 ± 1.0	2.9 ± 0.3	10 ± 2	30 ± 3
Film thickness upon spin coating [µm]		**						
3000 rpm	20		10	30	30	30	45	100
6000 - 1000 rpm	10-60		5 - 35	20 - 90	20 - 90	20 - 95	30 - 150	50 - 270
Spectral sensitivity photo-curing [nm]	300 - 410		300 - 410	300 - 390		300 - 410		
Hybridpolymer after photo-curing (λ = 365 nm) and hardbake (140 - 160°C)								
Volume shrinkage [%]	5 - 7		4 - 6	2 - 5	2 - 5	3 - 5	< 2	<< 2
Refractive Index (589 nm)	1.520		1.516	1.555	1.537	1.555	1.559	1.561
CTE (20-100 °C) [ppm/K]	60		105	100 - 130	100 - 130	130	130	130
dn/dT (589 nm) [10 ⁻⁴ /K]	-2.0		-1.5	-2.2	-2.7	-2.1	-2.3	-2.3
Young's modulus [GPa]	~1		~0.6	~1	~0.5	~1.2	~0.8	~0.8
Hardness (by indentation) [MPa]	~68		~36	~53	~24	~60	~90	~90
* Standard InkOrmo solutions available with viscosity of 7 mPas, 12 mPas, and 18 mPas			** Inkjet dispensing, no spin coating					

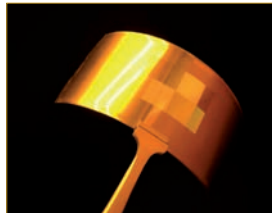
* Standard InkOrmo solutions available with viscosity of 7 mPas, 12 mPas, and 18 mPas ** Inkjet dispensing, no spin coating



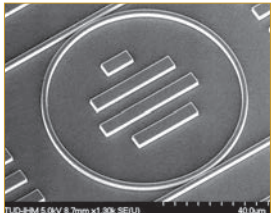
Microlenses on glass
(Courtesy of FhG IOF, Germany)



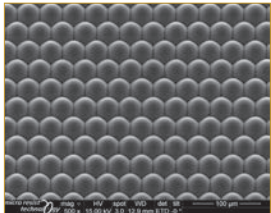
InkOrmo lenses on OrmoComp® pedestals - diameter of 100 µm
(Courtesy of EPFL/LMIS1, Switzerland)



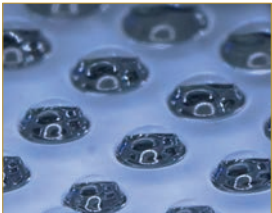
Flexible OrmoStamp® on nickel backplate
(Courtesy of PSI, Switzerland)



Replicated OrmoCore microring resonator
(Courtesy of TU Dresden)



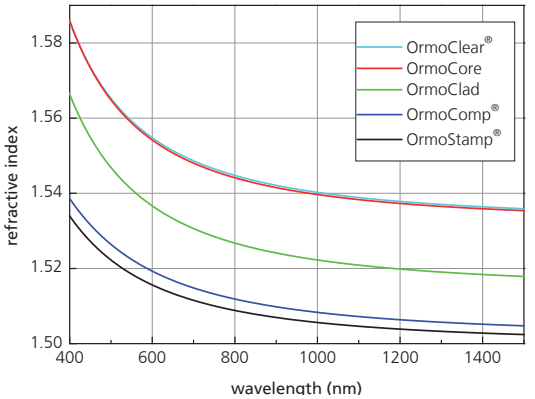
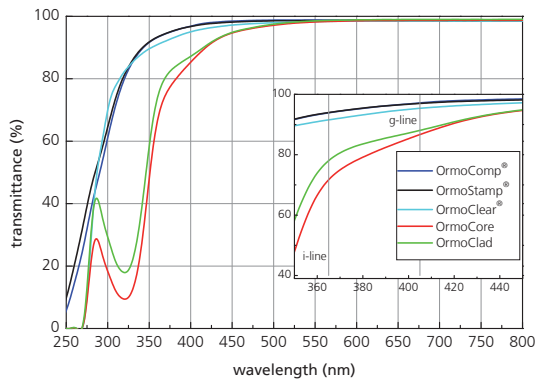
Replicated OrmoComp® microlens arrays



Replicated OrmoClear® macrolenses (Courtesy of HZB)

Main Features and Optical Properties

- UV lithography and UV molding
- Two-photon absorption (TPA) fabrication (OrmoComp® only)
- High resolution down to 100 nm feature size
- Highly transparent for VIS and near UV down to 350 nm
- High thermal stability up to 300 °C (short term), 270 °C (long term)
- High mechanical stability



Applications

Micro Optical Components

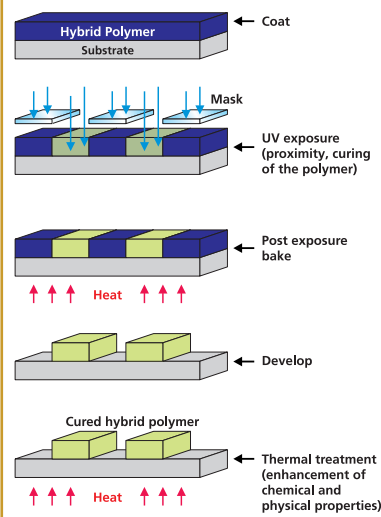
Transparent Stamps

Optical Waveguides

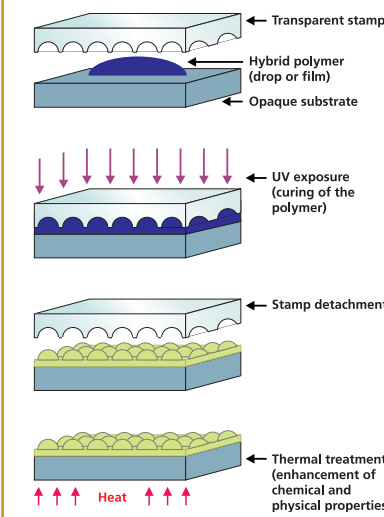
Micro Optical Components

Selection Guide	OrmoComp®	InkOrmo	OrmoStamp®	OrmoCore	OrmoClad	OrmoClear®	OrmoClear®10	OrmoClear®30
Process Compatibility								
Photolithography (mask-lithography)	•		•	•	•	•	•	•
UV molding	•		•	•	•	•	•	•
(Nano-)imprinting	•		•	•	•	•	•	•
Direct laser writing, TPA	•							
Ink-jet dispensing		••						
Roll-to-roll / Roll-to-plate processing	•		•					
Preferred Applications								
Microlenses, gratings, prisms, DOEs	•	•				•	•	•
Waveguiding				••	••	•	•	•
Bio applications, lab-on-chip, microfluidics	••					•	•	•
Replication with hard molds (quartz, Ni etc.)	•	•	•	•	•	•	•	•
Replication with PDMS molds (no oxygen sensitivity)	•		•					
Working stamp fabrication (e.g. for NIL)			••					
Material Compatibility								
Si and SiO ₂ substrates	•	•	•	•	•	•	•	•
Plastic substrates	•		•					

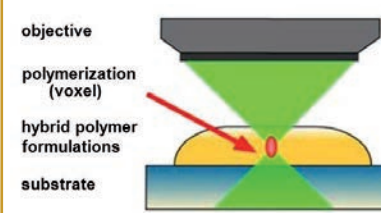
Process flow UV lithography



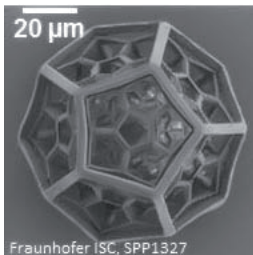
Process flow imprint lithography



Two-photon absorption (TPA) process (OrmoComp® only)

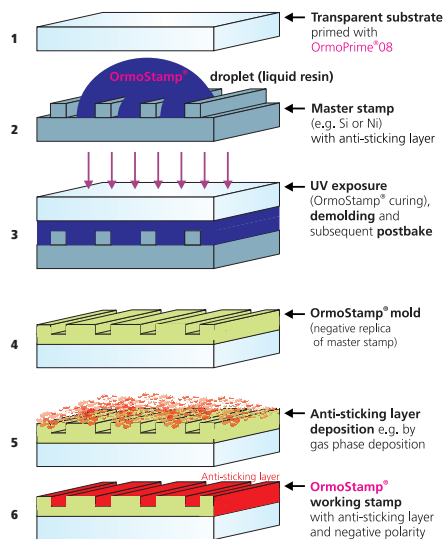


(Courtesy of Multiphoton Optics GmbH)



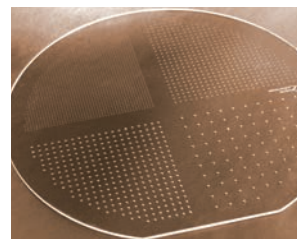
OrmoStamp® for Transparent Polymer Working Stamps

Process flow for working stamp fabrication



Main Applications - Stamp Fabrication

- Transparent working stamp fabrication
- (Nano)Imprint processes
- Cost efficient alternative to quartz stamps



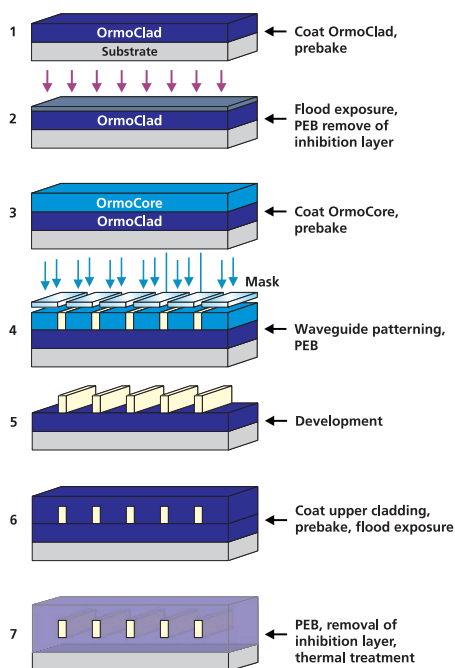
Large area replication of OrmoStamp® using 6 inch glass substrate

Main Features - Stamp Fabrication

- For UV-based and thermal imprinting
- Highly transparent for near UV and visible light
- Excellent pattern replication
- High mechanical stability
- Thermal stability up to 270 °C (short term)
- Enhanced anti-adhesive properties for low release forces

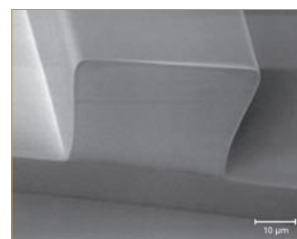
OrmoCore and OrmoClad for Optical Waveguide Fabrication

Process flow for waveguide fabrication



Main Applications - Optical Waveguides

- Single-mode waveguides
- Multi-mode waveguides
- Beam splitters
- Thermo-optical switches
- Microring resonators



Undercladding/ core of a multimode waveguide on silicon (Courtesy of ACREO)

Main Features - Optical Waveguides

- UV lithography and UV moulding
- Low optical loss at datacom wavelengths
- Tunable refractive index (Core/Clad ratios)
- High resolution down to 100 nm feature size
- Thermal stability up to 270 °C (short term)
- High mechanical stability

Ancillaries

Purpose	Ancillary	Features
Adhesion Promoter	OrmoPrime®08	- Recommended for various substrates like Si, glass, and quartz - Ready-to-use solution for spin coating - Film thickness 130 nm
Dilution of Hybrid Polymers *	OrmoThin ma-T 1050	Dilution for $d > 0.5 \mu\text{m}$ (product-dependent) * Dilution for $d < 0.5 \mu\text{m}$ (product-dependent) *
Developer	OrmoDev	- Removal of uncured material (e.g. after mask lithography was applied) - Immersion development

*For details of dilution ratios see corresponding processing guidelines

OrmoComp®: DE 30 210 075 433; IR 1 091 982 ; TW 100030626; OrmoClear®: DE 30 210 075 434; IR 1 091 359 ; TW 100030628

OrmoStamp®: DE 30 210 075 435; IR 1 092 621 ; TW 100030629; OrmoPrime®: DE 30 210 075 436

Hybrid polymers based on ORMOCER®s for micro-optics licensed by the Fraunhofergesellschaft zur Förderung der Angewandten Forschung in Deutschland e.V.