micro resist technology

UV-Curable Hybrid Polymers for Micro Optical Components

- OrmoComp®
- InkOrmo
- OrmoClear®
- OrmoClear®30
- OrmoClear®FX
- 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 -

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Product Overview

Material Specifications	OrmoComp®	InkOrmo	OrmoClear®	OrmoClear®30	OrmoClear®FX	OrmoStamp®	OrmoCore	OrmoClad
Liquid material before patterning process								
Solvent-free	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Viscosity [Pa·s]	2.0 ± 0.5	*	2.9 ± 0.3	30 ± 3	1.5 ± 0.3	0.4 ± 0.2	2.9 ± 0.4	2.5 ± 1.0
Film thickness upon spin coating [µm]		**						
3000 rpm	20		30	100	20	10	30	30
6000 - 1000 rpm	10-60		20 - 95	50 - 270	10 - 60	5 - 35	20 - 90	20 - 90
Spectral sensitivity photo-curing [nm]	300 - 410		300 - 410			300 - 410	300 - 390	
Hybridpolymer after photo-curing (λ = 365 nm) and hardbake (140 - 160°C)								
Volume shrinkage [%]	5 - 7		3 - 5	<< 2	3 - 5	4 - 6	2 - 5	2 - 5
Refractive Index (589 nm)	1.520		1.555	1.561	1.555	1.516	1.555	1.537
Abbe number	47		34	34	34	51	34	33
dn/dT (589 nm) [10^{-4}/K]	-2.0		-2.1	-2.3	-2.7	-1.5	-2.2	-2.7
CTE (20-150 °C) [ppm/K]	150		150	160	160	140	150	180
Young's modulus [GPa]	~1		~1.2	~0.8	n.d.	~0.6	~1	~0.5
Hardness (by indentation) [MPa]	~68		~60	~90	n.d.	~36	~53	~24

* 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)

Applications

Micro Optical Components | Transparent Stamps | Optical Waveguides

Selection Guide	OrmoComp®	InkOrmo	OrmoClear®	OrmoClear®30	OrmoClear®FX	OrmoStamp®	OrmoCore	OrmoClad
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	•					•		

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

Process flow UV lithography

Process flow imprint lithography

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

(Courtesy of Multiphoton Optics GmbH)

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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	**OrmoPrime08**	- 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 µm (product-dependent) * Dilution for d < 0.5 µm (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
Hybrid polymers based on ORMOCER®s for micro-optics licensed by the Fraunhofergesellschaft zur Förderung der Angewandten Forschung in Deutschland e.V.

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