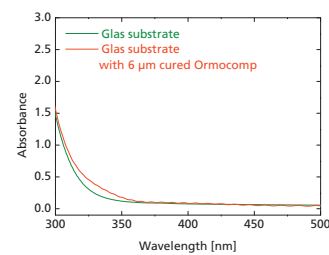
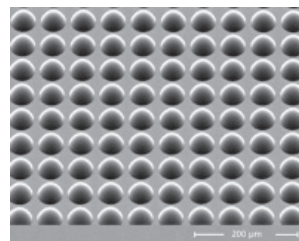


Ormocer®s for micro-optical Applications

Properties of the cured materials	Ormocomp	Ormocore
Thermal stability	Weight loss < 5 % up to 270 °C (5 K min ⁻¹)	
Thermal behaviour	Duromeric	
Shrinkage (during curing)	5 - 7 % by volume	3 - 5 % by volume
CTE (20 - 100 °C)	60 ppm K ⁻¹	100 - 130 ppm K ⁻¹
Refractive index @ 635 nm @ 800 nm	1.518 1.513	1.553 1.543



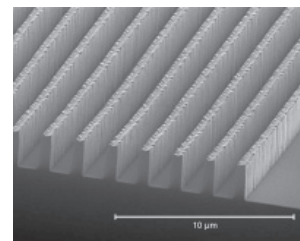
Optical transparency Ormocomp



Ormocomp replicated 10x10 micro lens arrays



Replicated sol-gel refractive microlenses on a VCSEL wafer substrate (Courtesy of Avalon)



Optical grating (Courtesy of FSU - Jena)

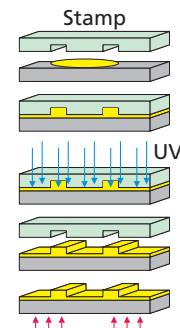
Ormocomp UV-curable material for imprinting, moulding and conventional lithography

- Highly transparent down to 350 nm
- UV-patternable (lithography / moulding)
- High resolution to sub-100 nm linewidth
- Exposure: i-line, h-line, broadband
- Fast curing
- Water absorption < 0.5 %
- Surface roughness 2 - 4 nm
- 6 months shelf life
- Thermally stable up to 270 °C
- Solvent-free

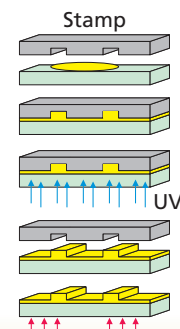
Main applications

- Moulded gratings
- Micro lenses
- Micro lens arrays
- Optical couplers and connectors
- Prisms

Process flow UV moulding Transparent Stamp



Process flow UV moulding Opaque Stamp



Ormocore hybrid polymer for micro-optical components & micro systems

- UV-patternable
- Highly transparent at the datacom and telecom wavelengths
- Thermally stable up to 270 °C
- Fast curing
- Solvent-free

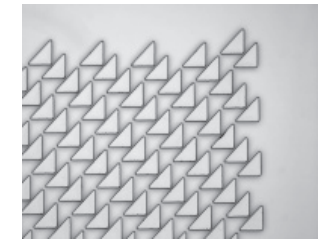
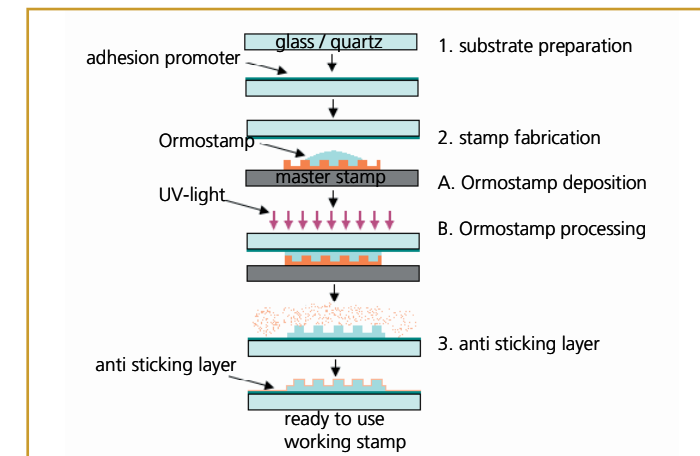
Main applications

- Optical sensors and sensor systems
- Displays
- Optical measurement systems
- Single elements or wafer scale

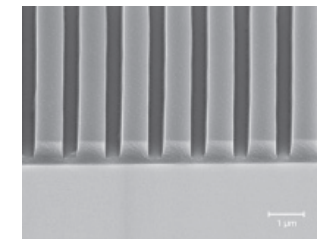
Ormocer®s for Innovative Technologies

Ormostamp for transparent stamps manufacturing

- Cost-efficient alternative to silica stamps
- Excellent fidelity to the master stamp
- Highly transparent to visible light down to 350 nm
- High resolution to sub-100 nm linewidth
- Convenient processing with standard lithography equipment
- Mechanically stable
- High thermal stability
- One-step or two-step fabrication possible



Microstructures replicated with a stamp made of Ormostamp



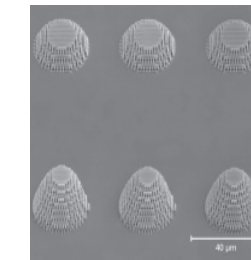
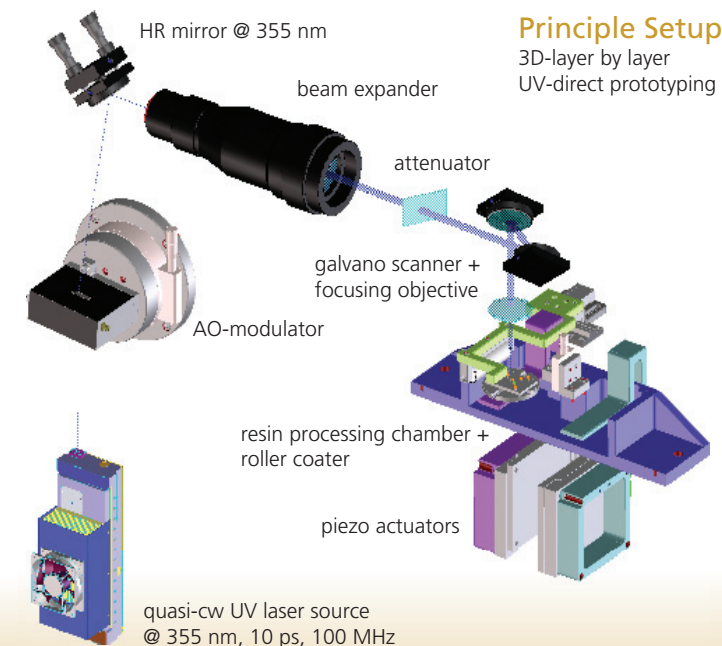
mr-UVCur06 nanostructures imprinted with an Ormostamp mould

Direct prototyping and micropatterning* Technologies: 3D-layer by layer UV-direct prototyping and 2-photon polymerisation

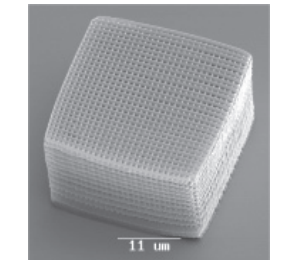
- Laser: 355 nm, 20 mW, 100 Mhz
- Scanner: 100 mm focal distance, scanning area 50 x 50 mm
- Resolution: < 10 µm vertical 5 µm lateral
- Positioning with piezo actuators

Main technology applications

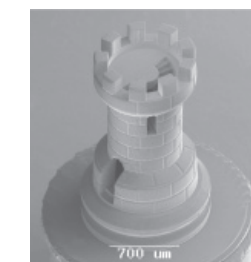
- Micro mechanics
- Micro sensors
- Micro fluidics



Photonic crystals produced with 2-photon polymerisation



Photonic crystals produced with 2-photon polymerisation



Micro item (chess tower) produced with 3D-layer by layer UV-direct prototyping



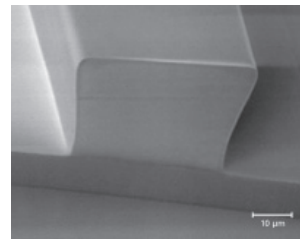
Windmill for fluidic media with a gearwheel connection produced with 3D-layer by layer UV-direct prototyping

* in collaboration with Laser Zentrum Hannover e. V.

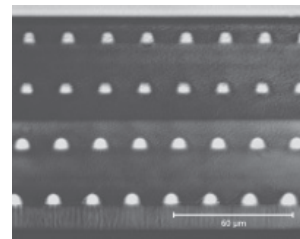
(Courtesy of Laser Zentrum Hannover e.V.)

Ormocer®s for Planar Optical Wave Guides

Properties of cured polymers	Ormocore	Ormoclad
Thermal stability	Weight loss < 5 % up to 270 °C (5 K min ⁻¹)	
Film quality	Good planarisation properties	
Water absorption	< 0.5 %	
CTE (20 - 100 °C)	100 - 130 ppm K ⁻¹	
Rms roughness	2 - 4 nm	
Shrinkage (during curing)	2 - 5 % by volume	
Refractive index @ 635 nm	1.553	1.534



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



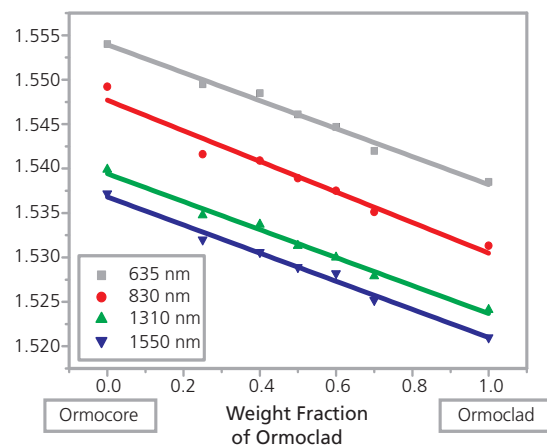
Multilayer optical fan out (Courtesy of FHG - IOF/Jena)

Ormocore and Ormoclad photo-patternable inorganic-organic hybrid polymers

- UV-patternable (lithography/ moulding)
- Exposure: i-line, broadband
- Tuneable refractive index (core/ clad)
- Low optical loss at datacom wavelengths
- Thermally stable up to 270 °C
- 6 months shelf life

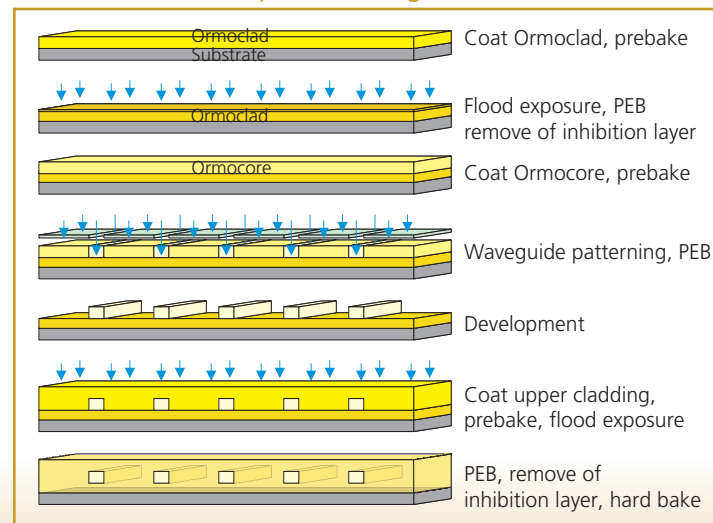
Main applications

- Single-mode wave guides
- Multi-mode wave guides
- Beam splitters
- Thermo-optical switches



Refractive index tuning

Process flow for optical wave guides



micro resist technology

Gesellschaft für chemische Materialien spezieller Photoresistsysteme mbH

Ormocer®s (Hybrid Polymers) for Micro Optics

Unique features of the Ormocomp, Ormocore, Ormoclad, Ormostamp, and materials for direct prototyping

- Excellent transparency
- Excellent mechanical properties
- High chemical and physical stability
- Excellent pattern transfer fidelity
- Ready-to-use solutions
- Solvent-free

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