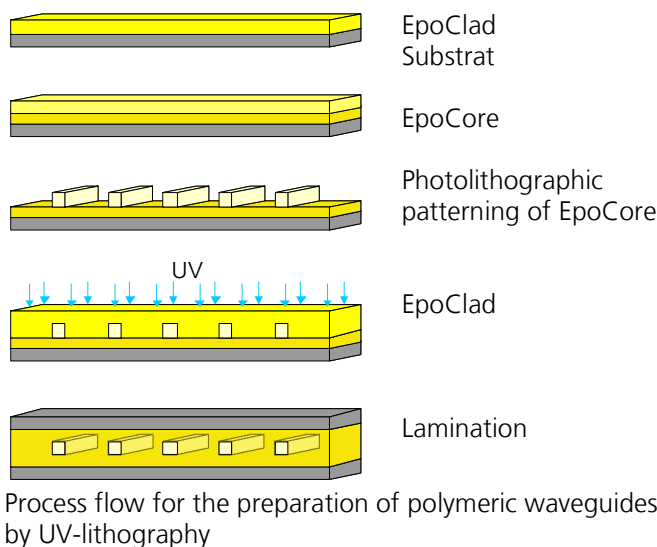


Negative Tone Photoresists EpoCore

Characteristics

EpoCore is a chemically amplified negative tone photoresist series for micro systems technology

- specifically designed for optical applications in micro systems technology
- application as a core material in optical wave guiding in combination with EpoClad
- UV sensitive
- high transparency to visible light
- excellent thermal stability of the resist patterns
- development in organic solvents



Physical properties of the resist solutions

Properties		EpoCore _2	EpoCore _5	EpoCore _10	EpoCore _20	EpoCore
Thickness range ¹	[μm]	1.5 – 5	3 – 14	6 – 25	10 – 60	20 – 80
	@ 3000 rpm, 30 s [μm]	2.0 ± 0.2	5.0 ± 0.5	10 ± 1	20 ± 2	-
	@ 1500 rpm, 60 s [μm]	-	-	-	-	50 ± 5
Dynamic viscosity ²	@ 150 s ⁻¹ [mPa*s]	87 ± 5	375 ± 20	1220 ± 50	3900 ± 150	10400 ± 600
	@ 1000 s ⁻¹ [mPa*s]	90 ± 5	385 ± 20	1130 ± 50	3000 ± 120	
Density ³	[g cm ⁻³]	1.175 ± 0.002	1.184 ± 0.002	1.191 ± 0.002	1.196 ± 0.002	1.200 ± 0.002
Refractive index n _D ²⁵		1.505 ± 0.002	1.521 ± 0.002	1.531 ± 0.002	1.540 ± 0.002	1.546 ± 0.002

¹ Spin coated at 750 to 6000 rpm, ² 25 °C, ³ 20 °C

Processing

Best patterning results are obtained at temperatures of 20 – 25 °C and a relative humidity of 40 – 46 %. The resist and unexposed resist films have to be processed under yellow light. The guidelines relate to standard processing of resist films spin coated on Si, SiO₂ or FR4. The specific process parameters to be applied depend on substrate, application and equipment.

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Processing conditions for EpoCore Series

Resist	EpoCore_2	EpoCore_5	EpoCore_10	EpoCore_20	EpoCore
Film thickness [μm]	2	5	10	20	50
Substrate preparation	Oven: 30 min @ 200°C for Si and SiO ₂ , Oxygen plasma for FR4, As waveguide on top of crosslinked EpoClad: oxygen plasma				
Spin coating [rpm]	3000	3000	3000	3000	1500
[s]	30	30	30	30	60
Relaxation [min]				10	15
Prebake					
Hotplate [°C]	50 / 90	50 / 90	50 / 90	50 / 90	50 / 85 - 90
[min]	2 / 2	2 / 4	2 / 4 - 5	2 / 4 - 5	5 / 10
Relaxation [min]			10	20	30
Exposure dose (365nm) ¹ [mJ cm ⁻²]	150 - 200	200 - 300	200 - 300	250 - 300	350 - 500
Post exposure bake (PEB)					
Hotplate [°C]	50 / 85	50 / 85	50 / 85	50 / 85	50 / 85
[min]	2 / 3	2 / 4	2 / 5	2 / 5	5 / 7 - 15
	Slow cooling down to room temperature				
Relaxation [h]	0.5	0.5	1	1	2
Development ² mr-Dev 600 [s]	45 ± 10	45 ± 10	60 ± 20	150 ± 20	180 ± 20
Hardbake					
Hotplate [°C]	120 - 140				
[min]	30 - 60				

¹ broadband exposure, intensity measured at λ=365 nm, ² immersion development

Substrate preparation:

The substrates have to be free of impurities and moisture. They should be baked at 200 °C and cooled to room temperature immediately before coating. Alternatively, oxygen or ozone plasma cleaning is recommended. Oxygen or ozone plasma cleaning is recommended for FR4 substrates.

Coating:

Uniform coatings are obtained by spin-coating of the EpoCore solutions in the thickness range indicated in the spin curves. Please select the appropriate resist type and spin speed required for the desired film thickness and application. The information refers to an open spin-coating system. Film thicknesses are attained with a single coat. The film thickness is measured after the prebake process.

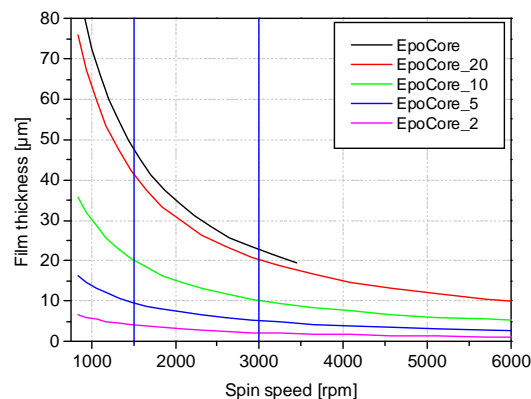


Fig. 1: Spin curves of EpoCore Series, 30 s spin time and 60 s spin time for EpoCore

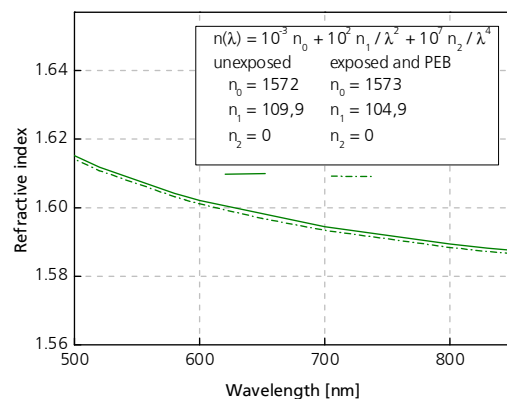


Fig. 2: Refractive index vs. wavelength, Cauchy coefficients of unexposed and of exposed and post exposure baked EpoCore series

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The refractive index of the resist film depending on the wavelength and the Cauchy equation are given in Fig. 2. This information is needed for ellipsometric or other optical thickness measurement.

Prebake:

Resist films are baked on a hotplate at 50 °C. Then the temperature is gradually (8 - 9 K/ min) increased to 85 - 90 °C and the film is baked at this temperature.

Exposure:

The resist is effective for broadband or i-line exposure.

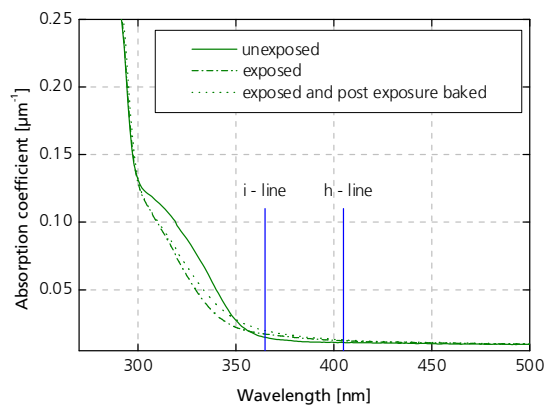


Fig. 3: UV/vis absorption of unexposed, exposed and post exposure baked EpoCore

Post exposure bake:

Immediately after exposure the resist films are baked at 50 °C on a hotplate. Then the temperature is gradually (8 – 9 K/min) increased to 85°C and the film is baked at this temperature. After the PEB the thicker resist films are slowly cooled down to room temperature.

Develop:

Ready-to-use developer **mr-Dev 600** is recommended. The temperature of the developer should be 20 – 25 °C. The developed resist films are thoroughly rinsed with isopropanol and then dried.

Hardbake:

If required, the etch resistance and the thermal stability of the resist can be further increased. Hardbaking of the developed resist patterns is suggested at 120 - 140 °C in an oven. A temperature ramp is beneficial in order to avoid pattern stress.

Removal:

Ready-to-use removers **mr-Rem 660** (NMP based) and **mr-Rem 500** (NMP free) are recommended. This also can be done at temperatures of 40 – 60 °C assisted by ultrasonics. Oxygen plasma is also suitable for the removal of the resist.

Please note that the material is strongly cross-linked after the processing and therefore its removal is not easy.

Storage

Storage at temperatures of 18 – 25 °C is recommended. Do not store EpoCore Series in a refrigerator. Resist and unprocessed resist films have to be stored under yellow light. Keep the bottle closed when not in use. Under these conditions a shelf life of 1 year from the date of manufacture is ensured.

Disposal

Unexposed resist: dispose of as halogen free solvent

Exposed resist: dispose of as resist/old resist

Environmental and health protection

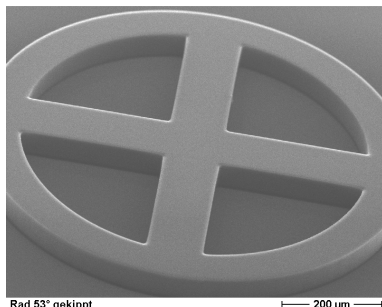
Ensure that there is adequate ventilation while processing the resist. Avoid contact of the resist with skin and eyes and breathing solvent vapours. Wear suitable protective clothing, safety goggles and gloves.

Equipment

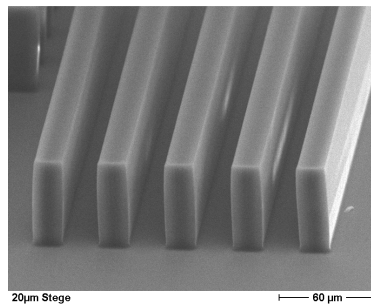
EpoCore Series is compatible with commercially available photoresist processing equipment. The data given in these guidelines were obtained using:

- Convac spin coater or Suss Delta 6 spin coater without cover
- Contact hotplate/ convection oven
- Suss MA 56 mask aligner (UV 400)
- Immersion development

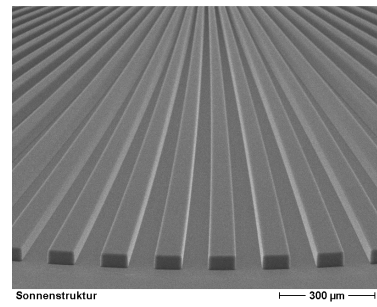
Patterning examples



Rad 53° gekippt
Fig. 4: 50 µm thick EpoCore, wheel structure



20µm Stege
Fig. 5: 50 µm thick EpoCore, 20 µm lines / spaces



Sonnenstruktur
Fig. 6: 40 µm EpoCore, sun structure

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