Bayfol® HX120

Description and Application Information

Bayfol® HX120 is a light-sensitive, self-processing photopolymer film which can be used to manufacture reflection and transmission volume-phase holograms. Bayfol® HX120 film can be recorded with appropriate laser light within the spectral range of 440 nm to 680 nm and is optimized for the spectral range of 500 nm to 680 nm.

Bayfol® HX120 film consists of a three layer stack of a substrate, the light-sensitive photopolymer and a protective cover film. A triacetate (TAC) substrate and a polyethylene terphthalate (PET) protective cover film are used.

Preliminary guide data

General properties

Property	Value	Unit of measurement	Method
Typical substrate thickness	60	microns	acc. to ISO 4593, 23°C
Typical photopolymer thickness	30	microns	IR Interferometer
Typical cover layer thickness	50	microns	acc. to ISO 4593, 23°C

Optical properties

Property	Value	Unit of measurement	Method
Transmittance (Unrecorded film, w/o cover foil)	See Annex graph 1, for details of the transmittance spectrum	%	ASTM E 01348

Holographic Performance Data: Reflection Holograms in 2-Beam Geometry

Property	Value	Unit of measurement	Method
Maximum refractive index modulation Δn_1 per recording wavelengt λ			acc. to ISO 17901-2
λ = 633 nm	> 0.04		
λ = 532 nm	> 0.04		
Typical recording dosage needed to achieve above Δn_1 values	See Annex graph 2, for details of the recording dosage	mJ/cm²	

Reflection Holograms in 2-Beam Geometry

Bayfol® HX120

In this recording geometry the photopolymer film is laminated onto a glass plate (75 mm x 50 mm x 1 mm).

The holographic recording is done with two coherent and collimated laser beams (plane waves), which penetrate the prepared sample from its two different surfaces. Both laser beams have S-polarization to maximize the interference contrast (fringe visibility) of the holographic recording.

The holographic recording itself is done with dosages which correspond to the product of the total incident power density ($P_R + P_S$) multiplied by the individual exposure times, t. More detailed conditions are depicted in the two following figures.

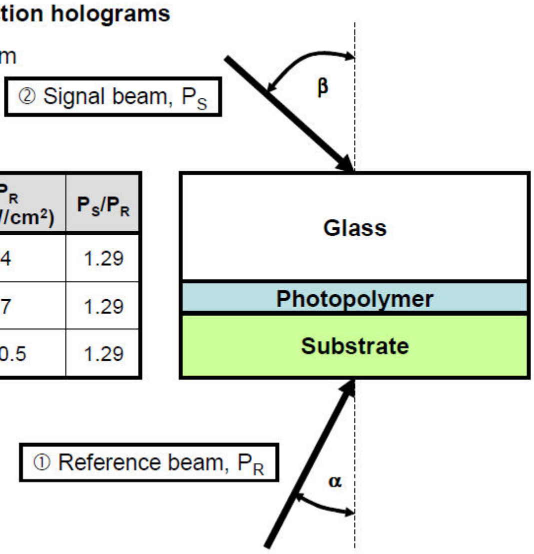
The ratio (P_S / P_R) = 1.29 compensates for the different size of the projected beam cross sections onto the sample surfaces and the different losses due to Fresnel reflections at the air sample interfaces in such a way that inside the photopolymer layer the beam ratio is equal to 1. This again facilitates maximum fringe visibility during the holographic recording.

After the holographic recording, the material is bleached using a dosage of approx. 5 J/cm² in the UV spectral range and simultaneously approx. 5 J/cm² in the visible spectral range.

Recording of slanted reflection holograms

- λ = 633 nm, 532 nm, 457 nm
- S-Polarization

λ (nm)	α (°)	β (°)	P_R (mW/cm²)	P_S/P_R
633	-22	42	4	1.29
532	-22	42	7	1.29
457	-22	42	10.5	1.29



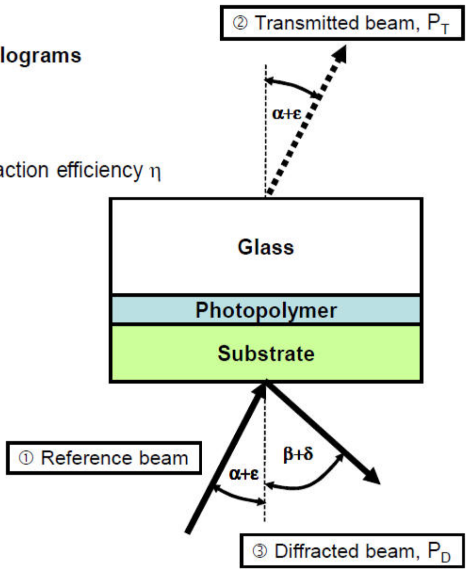
Bayfol® HX120

Readout of slanted reflection holograms

- λ = 633 nm, 532 nm, 457 nm
- S-Polarization
- Adjust ε and δ for maximum diffraction efficiency η

$$\eta = \frac{P_D}{P_T + P_D}$$

λ (nm)	α (°)	β (°)
633	-22	42
532	-22	42
457	-22	42



To determine the performance of the hologram, the diffraction efficiency η of the recorded hologram is measured with respect to the rotation angle α (the holographic film / glass sandwich is mounted on a rotation stage). The resulting Bragg curve η(α) is analyzed according to the Kogelnik theory* , to deduce the performance parameters η_{max}, Δn_1 and the effective thickness shrinkage. The effective thickness shrinkage is obtained from the angular shift ε, which measures the deviation from the recording angle α to the angle at which η_{max} is achieved. This thickness shrinkage is incorporated in the fit of Δn_1 according to Kogelnik theory.

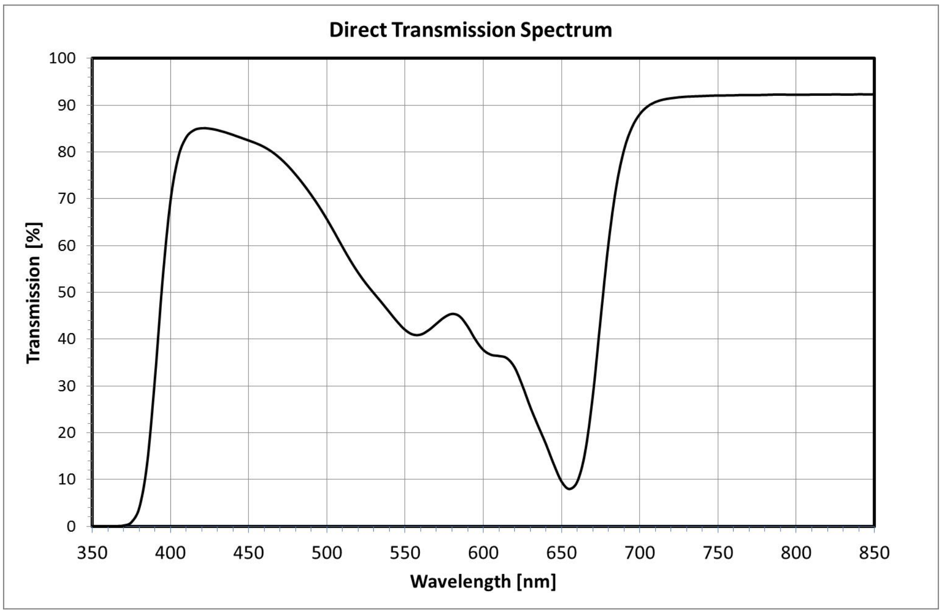
The mean refractive index used for the calculation is 1.51.

By varying the recording times the dosage response curves for Δn_1 at the different recording wavelengths, λ = 633 nm, 532 nm and 457 nm, can be obtained.

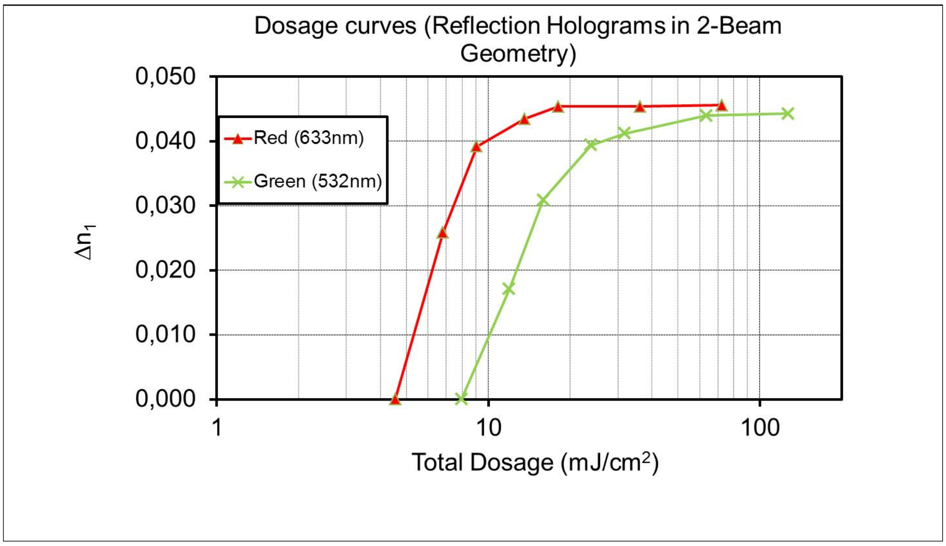
Source: *Kogelnik, H., "Coupled wave theory for thick hologram gratings", The Bell System Technical Journal 48(9), 2909-2947 (1969)

Bayfol® HX120

Graph 1: Transmittance



Graph 2: Index Modulation



Bayfol® HX120

Storage conditions	The unrecorded photopolymer film should be stored in the original and sealed Covestro packaging that is used for delivery. The unrecorded photopolymer film should be protected from light, humidity, heat , foreign materials and compressive load. Recommended storage temperature: +15 °C to +25 °C. Recommended relative humidity 45 % to 55 %
Storage time	Storage time 6 month.
Labeling and REACH applications	**This product data sheet is only valid in conjunction with the latest edition of the corresponding Safety Data Sheet.** Any updating of safety-relevant information – in accordance with statutory requirements – will only be reflected in the Safety Data Sheet, copies of which will be revised and distributed. Information relating to the current classification and labeling, applications and processing methods and further data relevant to safety can be found in the currently valid Safety Data Sheet.

Editor: Specialty Films
Covestro AG
Kaiser-Wilhelm-Allee 60
D-51373 Leverkusen
www.makrofol.com