Bayfol® HX200

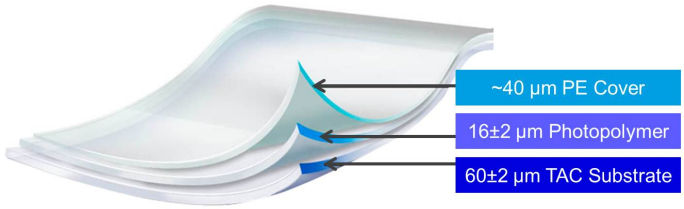
Description and Application Information

Bayfol® HX200 is a light-sensitive, self-developing photopolymer film which can be used to produce phase holograms in the form of volume reflection and volume transmission holograms. Bayfol® HX200 can be recorded with appropriate laser light within the visible spectral wavelength range from 440 nm to 680 nm. For hologram formation no further post-treatment is necessary, e.g. neither wet nor thermal treatment.

Bayfol® HX200 consists of a three layer stack of a substrate, a light-sensitive photopolymer and a protective cover film. The substrate is a cellulose triacetate film (TAC), and the protective cover is a polyethylene film (PE). The protective cover film can be removed from the photopolymer.

The product is capable of being used for a variety of types of volume holograms.

Layer Stack, Schematic



Guide data*

General properties

Property	Value	Unit of measurement	Method
Typical substrate thickness	60	microns	acc. to ISO 4593, 23°C
Typical photopolymer thickness	16	microns	white light interferometer
Typical cover layer thickness	40	microns	acc. to ISO 4593, 23°C

Optical properties

Property	Value	Unit of measurement	Method
Transmittance Unrecorded film, w/o cover foil See spectrum in the appendix		%	ASTM E 01348
Haze after UV flood cure 2)	< 2	%	ASTM D 1003
Index of refraction nD of the substrate	1.485		Prism coupler
Index of refraction nD of the photopolymer unrecorded	1.500		Prism coupler
Index of refraction nD of the photopolymer after UV flood cure 2)	1.505		Prism coupler

Bayfol® HX200

Holographic Performance Data:

Denisyuk Holograms

Property	Value	Unit of measurement	Method
Spectral diffraction efficiency η	> 95	%	ISO 17901-1, by transmittance of zero-order transmitted wave
Spectral bandwidth (full width at half maximum)	> 15	nm	ISO 17901-1, by transmittance of zero-order transmitted wave
Recording dosage (needed to achieve above mentioned values)	approx. 30	mJ/cm²	Recording wavelenght: λ = 532 nm; Power density: P_R= 4.6 mW/cm²

Holographic Performance Data:

Reflection Holograms in 2-Beam Geometry

Property	Value	Unit of measurement	Method
Maximum refractive index modulation Δn1 per recording wavelengt λ			ISO 17901-2
λ = 633 nm	> 0.03		
λ = 532 nm	> 0.03		
λ = 457 nm	> 0.03		
Typical recording dosage needed to achieve above Δn1 values			
λ = 633 nm Applied total dosage	approx. 15	mJ/cm²	
λ = 532 nm Applied total dosage	approx. 20	mJ/cm²	
λ = 457 nm Applied total dosage	approx. 25	mJ/cm²	

Shrinkage and Spectral Shift

Property	Value	Unit of measurement	Method
Effective thickness shrinkage after recording and UV flood cure 2)	approx. 1.4	%	Reflection holograms
Spectral shift after recording and UV flood cure 2)	approx. -8	nm	Denisyuk Holograms: wavelength deviation between recording / reconstruction

* These values provide general information and are not part of the product specification.

1) All values provide general information and are not part of the product specification.

2) Curing is done by means of a Mercury lamp; Company: Hönle; Typ: MH-Strahler UV-400 H);

dosage about 5,000-10,000 mJ/cm².

3) Holographic method: Denisyuk holograms

Reflection holograms are recorded in a Denisyuk setup with an expanded plane-wave laser beam.

The backside object is a plane mirror. Schematic figures of the setup are provided in the appendix.

4) Holographic method: Reflection holograms

ISO 17901-2 method to measure the amplitude of refractive index modulation using the reflection hologram, using two expanded plane-wave laser beams. Typical total power density: 9-23 mW/cm2.

The beams are s-polarized. External angles of incidence are -22° (object beam) and +42° (reference beam) in air, tilted to normal direction. Dosage curves and schematic figures of the setup are provided in the appendix.

General information about handling instructions under dark room conditions:

The product is light sensitive. Exposure to light prior to the holographic exposure might sacrifice the refractive index modulation Δn1 and diffraction efficiency η. Examples for tolerable expositions in dark room environment (dim yellow light) without sacrificing the holographic performance are given below:

Property	Value	Unit of measurement	Method
Maximum exposure intensity	2.6 [5)]	µW/cm²	Photopolymer film laminated on glass and illumiated positioned at a distance of 30 cm above.
	0.8 [6)]	µW/cm²	
Maximum exposure time	5 [5)]	min	see above
	30 [6)]	min	

5) Illuminant: OSRAM PARATHOM DECO CLASSIC A Yellow 1 Watt LED E27

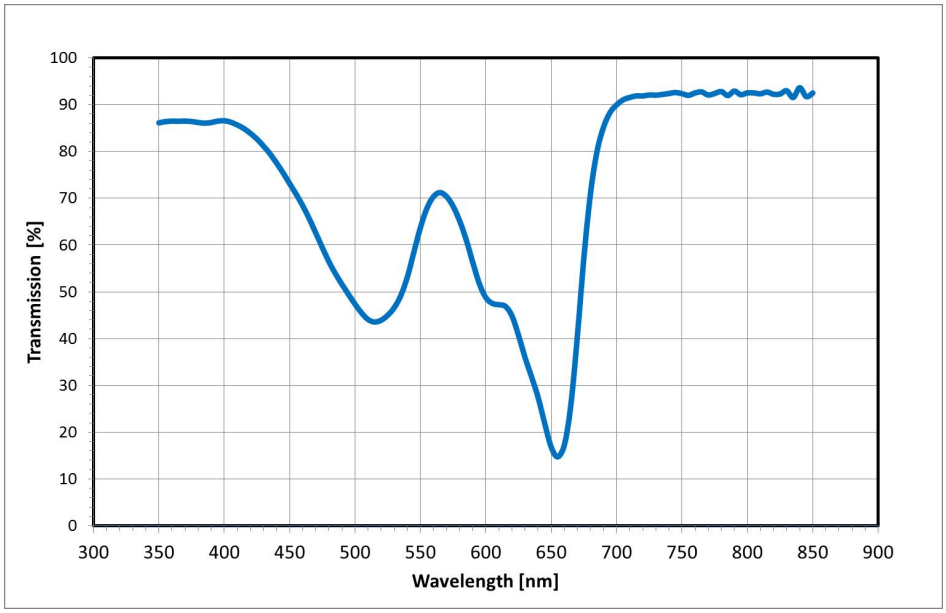
6) Illuminant: PHILIPS AccentColor Miniglobe Yellow 1 Watt LED E27

Transmissions spectrum of the unrecorded photopolymer film.

The transmission spectrum of the unrecorded photopolymer film was recorded after removal of the protective cover film.

The measurement is done in a darkened laboratory with a spectrometer according to ASTM E 01348.

Bayfol® HX200



General information for flood cure and bleaching:

These are recommendations and should serve as guidelines. According to the specific equipment components and the type of product to be produced, deviations from these guidelines might be necessary. The bleaching can also be adapted to the required product performance.

Example: Conditions for mercury lamps

High temperatures (above 60°C at the film) should be avoided because they can lead to deformation of the substrate. Dichroic mirrors that reflect UV-light and transmit IR-radiation and a fused silica panel in front of the lamp can reduce the amount of IR-radiation and thus further reduce the temperature.

The following conditions were found to be favorable:

• Photopolymer layer on substrate laminated to glass

• Dosage: 5,000-10,000 mJ/cm²

• Intensity at the sample: 40 mW/cm²

These data were found using a mercury lamp (MH-Strahler UV-400 H) of Hönle UV Technology (http://www.hoenle.de).

Safety

Bayfol® HX200

While there are no specific toxic threats, the Bayfol® HX200 film is a trial product that has not yet been fully tested. As such, safety precautions should be taken during its handling and use. Precautions should be taken to avoid direct contact of the unrecorded photopolymer with skin - gloves or other suitable personal protection devices should be used.

Storage conditions	The unrecorded photopolymer film should be stored in the original and sealed Covestro container that is used for delivery, whenever possible. The storage temperature shall be kept at ≥15°C and ≤ 25 °C. While the recorded film is quite stable, the unrecorded photopolymer film should be protected from light, humidity, heat and foreign materials.
Storage time	Six months Storage Time is recommended.
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.

Bayfol® HX200

The manner in which you use and the purpose to which you put and utilize our products, technical assistance and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations, are beyond our control. Therefore, it is imperative that you test our products, technical assistance, information and recommendations to determine to your own satisfaction whether our products, technical assistance and information are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by Covestro. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale which are available upon request. All information and technical assistance is given without warranty or guarantee and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance, and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with any claim of any patent relative to any material or its use. No license is implied or in fact granted under the claims of any patent.

This product is not designated for the manufacture of a medical device (1) or of intermediate products for medical devices. This product is also not designated for Food Contact (2), including drinking water, or cosmetic applications. If the intended use of the product is for the manufacture of a medical device or of intermediate products for medical devices, for Food Contact products or cosmetic applications Covestro must be contacted in advance to provide its agreement to sell such product for such purpose. Nonetheless, any determination as to whether a product is appropriate for use in a medical device or intermediate products for medical devices, for Food Contact products or cosmetic applications must be made solely by the purchaser of the product without relying upon any representations by Covestro.

(1) Please see the "Guidance on Use of Covestro Products in a Medical Application" document.
(2) As defined in Commission Regulation (EU) 1935/2004.

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