AR-N 4600 series (Atlas 46) for high film thickness

Negative photoresist for electroplating, microsystems and LIGA < 20 µm

AR-N 4600 series 產品說明

AR-N 4600系列，實驗代號Atlas 46，為高膜厚產品,適合於電鍍,微系統,微機電等各類應用。
產品編號: AR-N 4610 (S) – stable layer. 可做為結構的一部份。
AR-N 4650 (R) – removable layer. 適合於各類金屬電鍍製程。
產品基本資料如下：

		AR-N 4600-10 (S)	AR-N 4650-10 (R)
Viscosity@25℃ 黏度	mPa.s	172	314
Film thickness@1000rpm	um	10	
Resolution 解析度	um	2	
Contrast 對比		4	
Flash point 閃火點	℃	46	
Storage 6 months	℃	10 -22	8 - 12
Production status[1]		routine	on-demand

1.Production status：
on-demand：產品無固定排程生產，需先詢問價格。可能會有最小量訂單，或需等待批次生產排程。
Routine： 產品固定排程生產，交貨期約 2 - 4 週。

產品包裝：

- ✅ 250 ml/瓶
- ✅ 1 L/瓶

產品出貨：

- ✅ 2 – 4 週 德國出貨
- ❎ 1 週 國內庫存。(暫無國內存)

價格詢問 | 其它諮詢 | AR-N 4600-10 GHS標識

AR-N 4600 series (Atlas 46) for high film thickness

Negative photoresist for electroplating, microsystems and LIGA < 20 µm

Characterization 產品特性

- i-line, broadband UV
  曝光波長: 寬頻紫外線, i-line (365nm)
- very good adhesion properties
  黏著度良好
- very high sensitivity
  高敏感度
- 4600-10 for stable layers of 5 µm – 15 µm
  AR-N 4600-10應用於 厚度 5 um – 15 um的永久材
- 4650-10 for removable layers of 5 µm – 15 µm
  AR-N 4650-10應用於厚度 5 um -15 um的可去除光阻
- further film thicknesses up to about 200 µm available on request
  厚度可依需求調整,最高可達200 um。 如有需要請連絡
- poly[(o-cresyl glycidyl ether)-co-formaldehyde] and acid generator
  成份含PCGF-聚[(鄰甲苯基縮水甘油醚)—共甲醛]與光酸
- Safer solvent PGMEA
  使用較安全溶劑PGMEA

AR-N 4600 series (Atlas 46) for high film thickness

Negative photoresist for electroplating, microsystems and LIGA < 20 µm

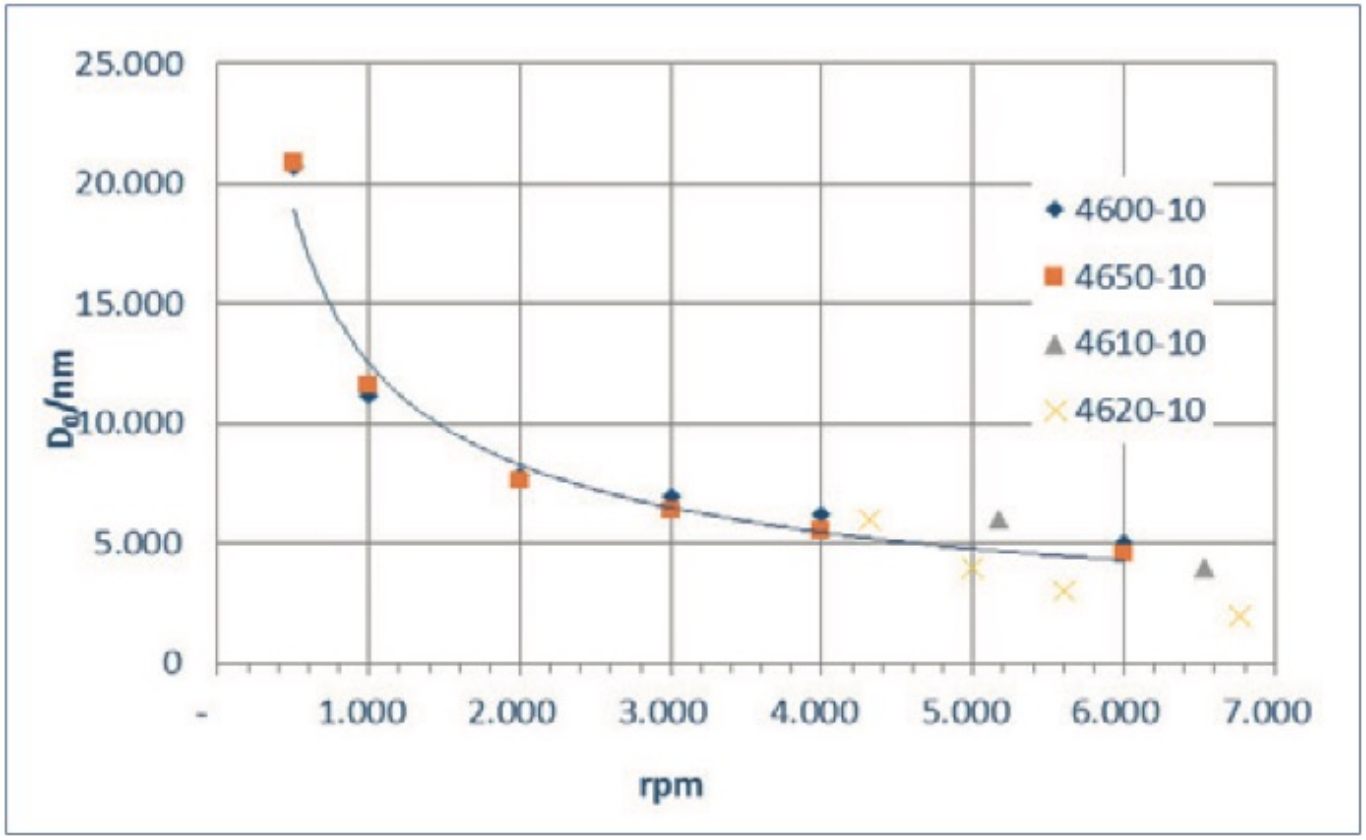
Property I			
Parameter		AR-N 4600-10 (S)	AR-N 4650-10 (R)
Solids content 固型份	%	50	50
Viscosity@25°C 黏度	mPa.s	172	314
Film thickness@1000rpm	um	10	
Resolution 解析度	um	2	
Contrast 對比		4	
Flash point 閃火點	°C	46	
Storage 6 months	°C	10 -22	8 - 12

Property II			
Glass trans. temperature	°C	34 - 44	
Softening point	°C	99	
Dielectric constant		3 – 3.3	
Cauchy coefficients (AR-P 1220)	N_0	1.675	
	N_1	67	
	N_2	101	
Plasma etching rate 1 Pa, O_2 Plasma 230W (ICP) 160W (HF)	nm/min	O_2	400
		5 CF_4 + 30 O_2	450

AR-N 4600 series (Atlas 46) for high film thickness

Negative photoresist for electroplating, microsystems and LIGA < 20 µm

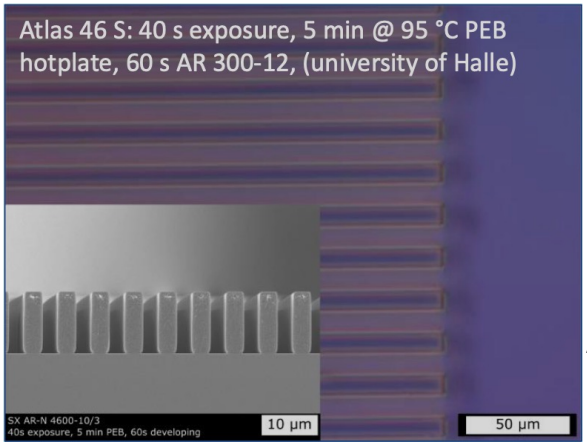
Spin curve of AR-N 4600 series



AR-N 4600 series (Atlas 46) for high film thickness

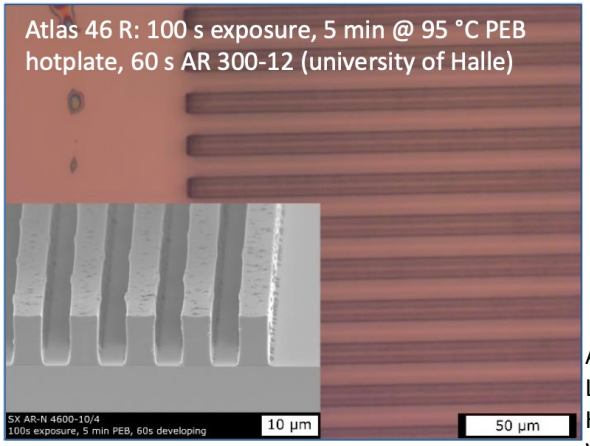
Negative photoresist for electroplating, microsystems and LIGA < 20 µm

Resist structures



Atlas S (© Martin Luther University Halle-Wittenberg

Resist structures



Atlas R (© Martin Luther University Halle-Wittenberg)

Process parameter

Substrate	Si 4” wafer
Soft-bake	95 °C x 5 min, hot plate
Exposure	BB UV, Soft-contact
Development	AR 300-12, 120 sec,20°C

Process chemicals

Remover	AR 300-12, AR 600-70
Thinner	AR 300-12
Developer	AR 300-12, AR 600-70
Stopper	AR 600-60

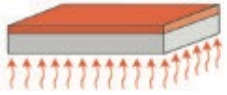
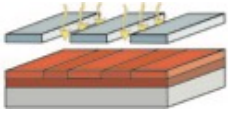
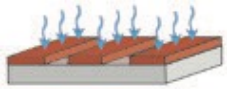
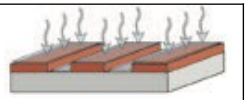
AR-N 4600 series (Atlas 46) for high film thickness

Negative photoresist for electroplating, microsystems and LIGA < 20 µm

Process baseline

This diagram shows exemplary process steps for resist AR-N 4600. All specifications are guideline values which must be adapted to own specific conditions. For further information on processing. 👉" Detailed instructions for optimum processing of photoresists". For recommendations on wastewater treatment and general safety instructions 👉" General product information on Allresist photoresists".

圖示AR-N 4600系列產品製程參數的範例. 所有參數為參考值,使用者應依設備環境實際狀況加以調整

Coating (open chuck)		AR-N 4600-10 (Atlas S)	AR-N 4650-10 (Atlas R)
		10 um@1000rpm	
Soft bake		90°C x 5 min hot plate (65°C x 2 min – 95°C x 4 min)	
UV exposure		Broadband UV, i-line/Exposure dose (E_0 broadband UV)	
		120 mJ/cm²	140 mJ/cm²
Cross-linking bake		105°C x 5 min hot plate (65°C x 2 min – 95°C x 7 min – 105°C x 2 min)	
Development (21-23±0.5°C) puddle		AR 300-12, 2 min	
Rinse		AR 600-60, DI water, - drying (hot plate)	
Customer specific technology		Hard bake (optional) (95°C x 10 min/105 °C x 5 min) up to 200°C (gradually)	
Removal		O_2 plasma ashing	AR 600-70 x 30-40min O_2 plasma ashing

Reference data for process tuning

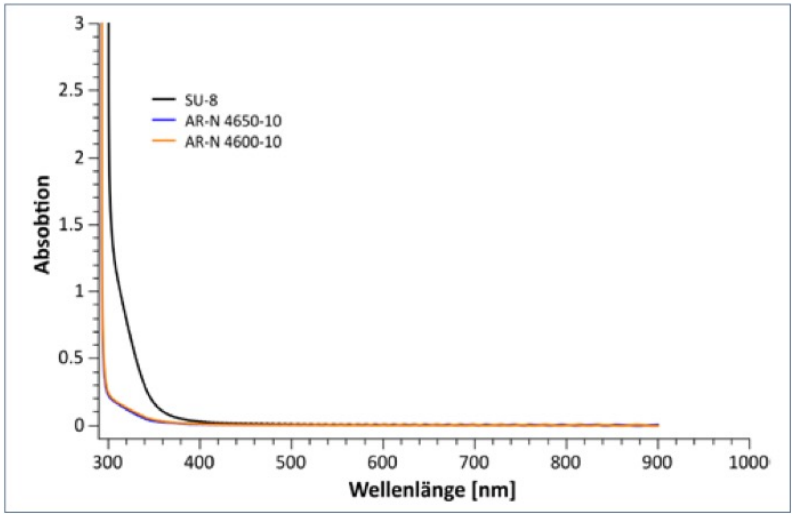
Development recommendations

	Resist	
Developer	AR-N 4600-10	AR-N 4650-10
AR 600-70	fast	fast
AR 300-12	middle	middle
AR 600-07	slow	slow

AR-N 4600 series (Atlas 46) for high film thickness

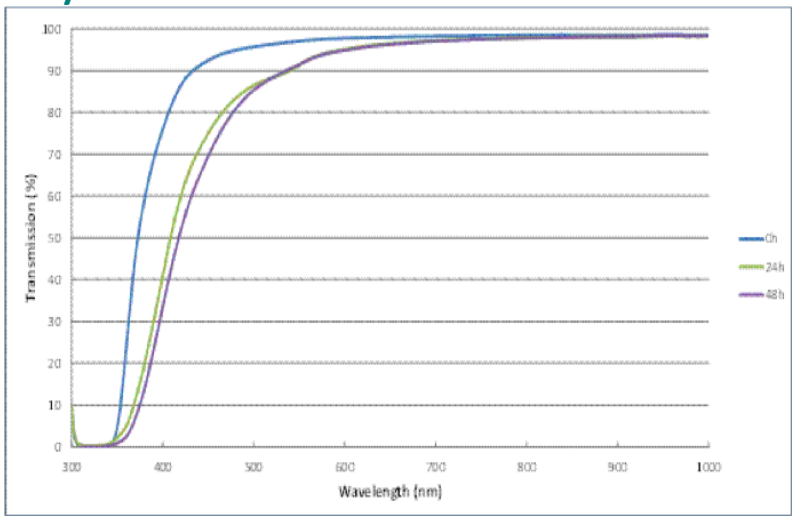
Negative photoresist for electroplating, microsystems and LIGA < 20 µm

UV/VIS NIR



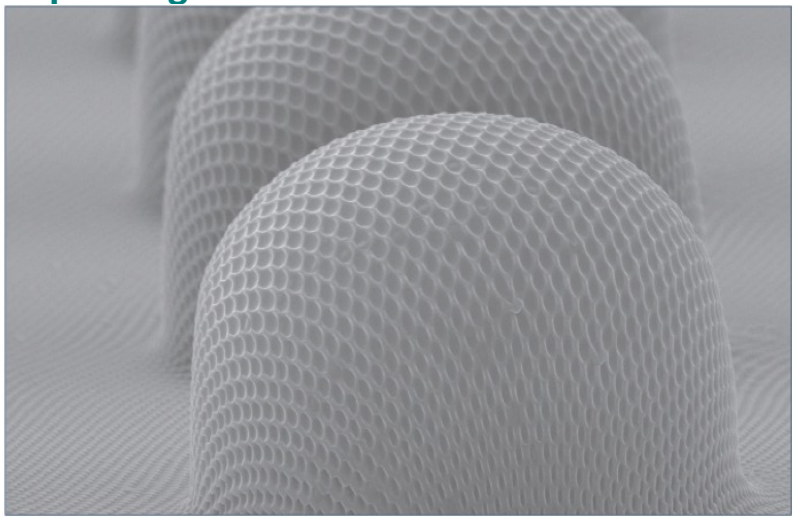
UV/VIS spectra of 10 µm layers Atlas S and Atlas R in comparison to SU-8

UV/VIS NIR



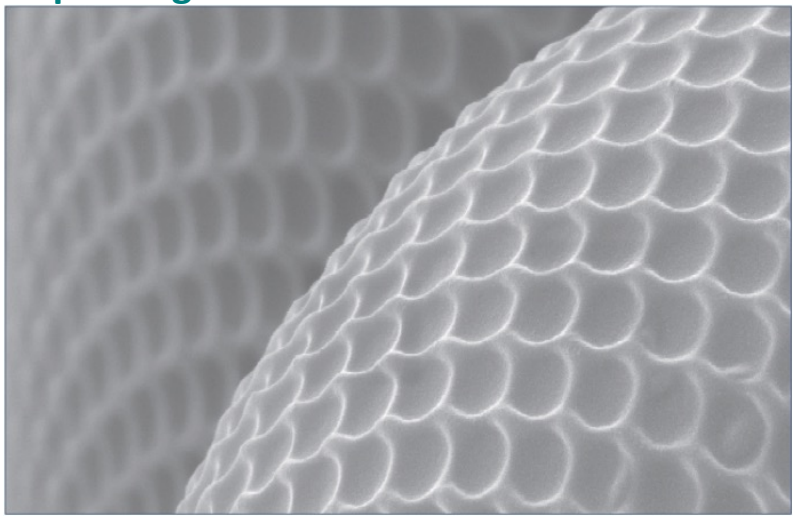
UV/VIS spectra of Atlas 46. Yellowing caused by varying the duration of broadband UV exposure after curing.

Imprinting



Combined nano- and microstructures, produced by imprinting of AR-N 4600 (© Uni Wuppertal)

Imprinting

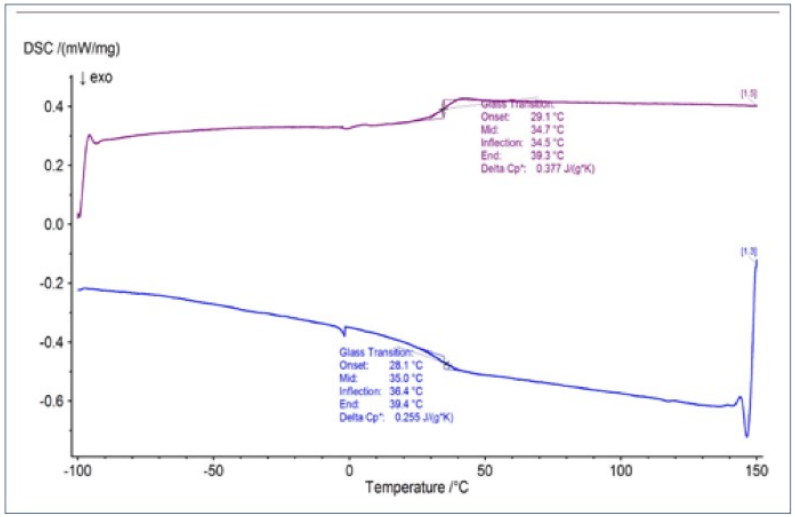


Close-up view of AR-N 4600 (© Uni Wuppertal)

AR-N 4600 series (Atlas 46) for high film thickness

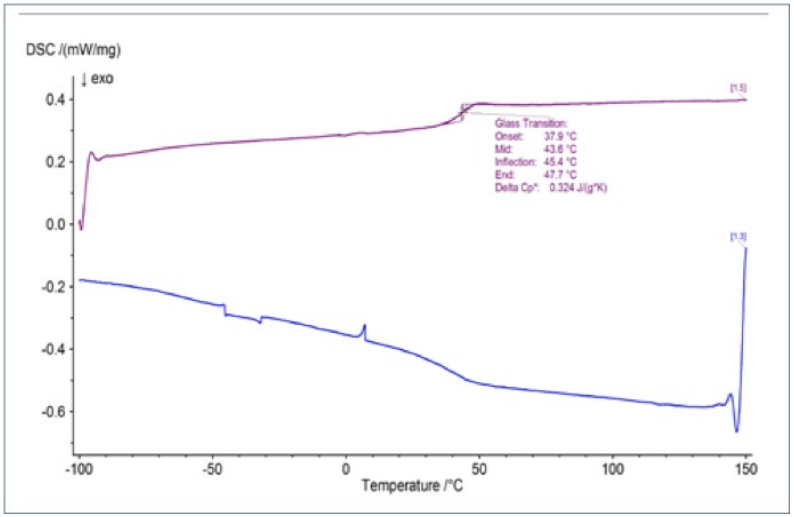
Negative photoresist for electroplating, microsystems and LIGA < 20 µm

DSC



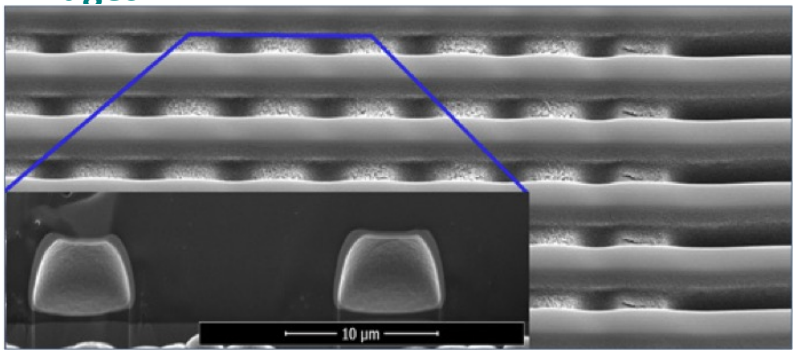
Dynamic differential scanning calorimetry (DSC) of Atlas S

DSC



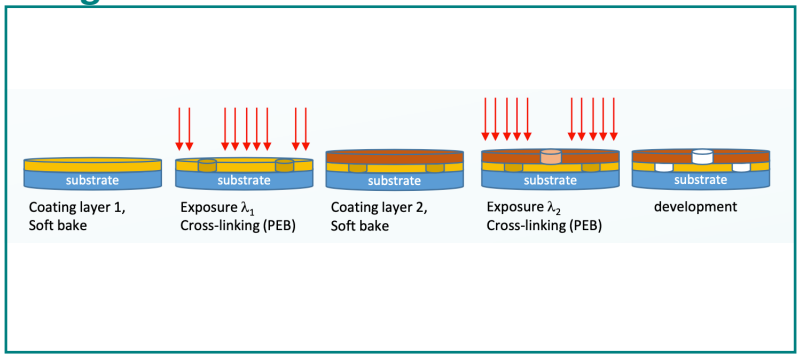
Dynamic differential scanning calorimetry (DSC) of Atlas R

Bridges



Bridge structure of two-layer system with AR-N 4600-10 (bottom) and SX AR-N 4620-10/1 (top)

Bridges



Process description of "bridge construction" with AR-N 4600-10 (bottom, BB-UV) and SX AR-N 4620-10/1 (top, g-line)

Additional information

Processing

Layer thickness values of Atlas R and Atlas S are pre-adjusted to 10 µm at a spin speed of 1000 rpm. It is recommended to perform the subsequent tempering step on the hotplate at 95 °C for 5 min. Temperature ramps or stepwise drying, e.g., 65 °C for 2 minutes, followed by 95 °C for 4 minutes, can improve the resolution.
Both resists can be structured by i-line or broadband UV exposure. Prior to irradiation, substrates should be cooled to room temperature. It is recommended to perform the following tempering step for cross-linking on the hotplate at 105 °C for 2 min.
Ramps or stepwise cross-linking procedures like e.g. 65 °C for 2 minutes, followed by 95 °C for 7 minutes and 105 °C for 2 minutes, can improve the resolution. In general, the stability of resists increases with higher temperatures and longer bake times, but this requires on the other side longer development times. The use of temperature ramps is also recommended for cooling since cooling too fast may result in stress cracking.

Atlas R及Atlas S的厚度是事先調整為轉速1000 rpm時為10um. 接著建議以熱板加熱95°Cx5min. 階梯式升溫可改善解析度,例如: 65°C x 2 min, 再以95°C x 4 min.

Atlas R及Atlas S曝光波長為寬頻紫外線(broadband UV)或365nm (i-line). 曝光前,晶片應先冷卻至室溫. 曝後烤建議溫度時間為: 105°C x 2min (熱板). 階梯式曝後烤亦可改善解析度, 例如: 65°C x 2 min, 95°C x 7 min, 105°C x 2 min. 一般而言,較高溫度與較長烘烤時間可增加光阻的穩定度, 但同時也需要較長的顯影的時間.

晶片冷卻時也建議採階梯式降溫,可避免因降溫速度過快,光阻因應力而產生裂痕.

Additional information

Processing-Development

AR 300-12 is recommended as standard developer, but also AR 600-07 (fast development) or AR 600-70 (gentle development) is suitable. If AR-N 4600-10 (S) is used for development, no dark erosion is observed even after comparably long development times. If the development with AR 300-12 is performed for too long, increased dark erosion of AR-N 4650-10 may result, and a too long development with AR 600-70 can even cause complete removal.

Stopper AR 600-60 is recommended for a particularly residue-free rinsing after development, followed by rinsing with DI water. It is also possible to rinse resist layers immediately after development directly with DI water and to dry them on the hotplate.

The sensitivity for a layer thickness of 10 µm is about 110 – 160 mJ/cm² in the broadband UV range (process description on page 3).

顯影劑一般建議使用標準度AR 300-12,但AR 600-70(顯影速度快)及AR 600-07(顯影速度慢)一樣適用. AR-N 4600-10(S)即使在長的顯影時間也觀察不到顯影劑對光阻蝕刻的問題. AR-N 4650-10(R)如果在AR 300-12顯影時間過長,就容易發生顯影劑對光阻蝕刻現象, 在AR 600-70顯影時間過長,甚至會使光阻去除.

AR 600-60建議使用於顯影後,接著再以DI water潤洗. 也可以顯影後直接以DI water潤洗,再以熱板乾燥.

曝光敏感度大約是:10um厚度於寬頻紫外線110 – 160 mJ/cm²

Removal

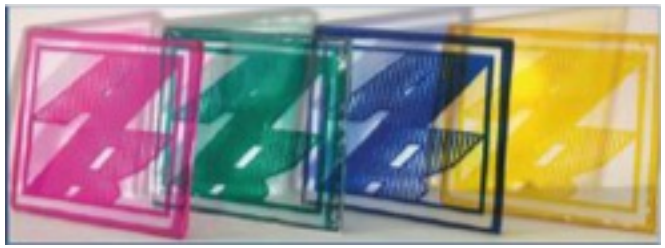
Coated structures of AR-N 4650-10 (R) can be removed with thinner AR 300-12 or AR 600-70. Depending on the degree of cross-linking (dose, temperature and bake time), required removal times may be considerably longer than 30 minutes.

AR-N 4650-10(R)的結構可被AR 300-12或AR 600-70去除. 依阻劑架橋程度(曝光劑量,烘烤溫度與時間),一般去除時間會超過30分.

Dyed and fluorescent films with Atlas 46

Different colored, optionally also fluorescent dyes can be embedded into the negative-working Atlas 46 S. These dyes are process-stable, and structuring is performed in the same manner as in standard processes with uncolou- red Atlas 46 S films.

Atlas 46(S)負型光阻可加入不同顏色染料或螢光染料. 製程穩定,與未加染料時的參數一樣. 圖示為5um膜厚加入不同顏色的公司標示.



Varicoloured company logo with Atlas 46 S, film thickness 5 µm

The use of different fluorescent dyes allows a defined adjustable emission in variable wavelength ranges. Fluorescent resist films are e.g., applied in microscopy. By embedding dyes into Atlas 46 S, resist films can be created that optionally show violet, blue, green, yellow, orange or red fluorescence. The intense fluorescence is retained even after a tempering at 150 °C, and the intense UV exposure required for cross-linking of Atlas films exhibits no adverse effect on the emission properties of these layers.

螢光染料可依需求調整不同波長的螢光.俱螢光反應的光阻膜,例如在顯微鏡的應用. 在Atlas 46(S)中加入螢光染料,依需求可顯示紫色,藍色,綠色,黃色,橘色或紅色.螢光的強度及特性不會受到製程中加熱150°C,及紫外光曝光,高分子架橋等因素影響.

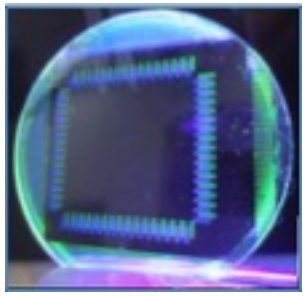
Differently fluorescing Atlas 46 films (irradiation with black light)

Dyed and fluorescent films with Atlas 46

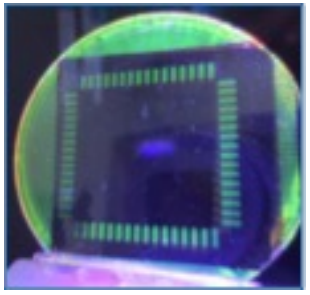
Also, two-color fluorescent resist architectures could be realized. For this purpose, glass panes were pre-treated with AR 300-80new to optimize the adhesive properties and subsequently coated with different fluorescent Atlas 46 S variants. Exposure was carried out using different masks. After the following PEB, development was carried out with AR 300-12 and films were dried. The developed
structures were then coated with a second, differently colored resist variant with the greatest possible color contrast, e.g., blue – yellow or red – yellow.
No mixing occurred since the already produced structures turned out to be highly stable. The second exposure and PEB step analogous to the first step allowed a selective structuring of the upper layer. After development with AR 300-12, the differently fluorescing areas on the substrate become visible in black light:
雙色螢光製程:玻璃基板先以AR 300-80new以增加黏度, 再塗佈參雜不同螢光染料的Atlas 46(S). 接著以不同光罩進行曝光. 曝後烤後以AR 300-12進行顯影並乾燥. 緊接著進行第二層不同顏色的製程. 顏色選擇儘量以最大對比的組合,例如:藍-黃,或,紅-黃.
兩段製程各自形成穩定的結構,不會有混合的情況. 第二段製程的曝光及曝後烤可再上層形成選擇性結構,以AR 300-12顯影後就可形成不同顏色的發光區域.

AR logo realized with two-colored emission in black light

Also, differently fluorescent lines adjacent to each other (or optionally overlapping) can be created in the same way. 相鄰或重疊的螢光線條也可以此製程製作.



parallel arrangement



overlapping lines