Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

AR-N 4400系列產品說明

AR-N 4400系列(CAR 44)為高膜厚光阻,適合電鍍,微系統,微機電等各類應用。產品基本資料如下：

		AR-N 4400-05	AR-N 4400-10	AR-N 4450-10T	AR-N 4400-25	AR-N 4400-50
Film thickness@1000 – 250 rpm	um	5 - 10	10 - 20	10 - 20	25 - 50	50 - 100
Resolution	um	1.0	2.0	3.5	3.5	5.0
Contrast		4.0	4.0	10	5	6
Flash point	°C	46				
Storage 6 months[1]	°C	10 - 18				
Production status[2]		routine	routine	on-demand	routine	routine
GHS label		GHS 標識	GHS 標識	GHS 標識	GHS 標識	GHS 標識

1 Product is guaranteed 6 months shelf life from the data of sale if stored correctly.
在正確的儲存條件下,產品保證的有效期為銷售日起6個月

Product can also be used without guarantee until the date indicated on the label
在無提供保證的情況下,產品可使用至標籤上所示的有效期

2 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

其它包裝可依客戶需求增加.

價格詢問　其它諮詢

出貨:

- ✅ 2 – 4 週。德國運出。
- ❎ 1 週。國內庫存。

(本產品目前暫無國內庫存)

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

Characterization 產品特性

- broadband UV, i-line, g-line, e-beam, X-ray, synchrotron
  適合各類曝光;寬頻紫外線, i-line, g-line, 電子束,x光,同步輻射
- chemically enhanced, very good adhesion, electro plating-stable
  化學放大型光阻. 與基板介面接著性良好. 於電鍍製程穩定
- very high sensitivity, easy removal
  光阻具高敏感度,且去除容易
- profiles with high edge steepness for excellent resolution, covering of topologies
  光阻圖案側視具垂直邊緣,解析度高
- 4400-05 for film thicknesses up to 10 µm (250 rpm)
  4400-05膜厚在250轉可達10um
- 4400-10 for film thicknesses up to 20 µm (250 rpm)
  4400-10膜厚在250轉可達20um
- 4450-10T for film thicknesses up to 20 µm and lift-off, developing by TMAH 0.26n
  4450-10T膜厚在250轉可達20um,適lift-off及TMAH (0.26n)顯影
- 4400-25 for very thick film up to 50um (250 rpm)
  4400-25膜厚在250轉可達50um
- 4400-50 for highest film thickness up to 100 um
  4400-50膜厚可達100um
- novolac, crosslinking agent, amine-based acid generator
  成份含酚醛樹脂,架橋劑,胺基光酸
- safer solvent PGMEA
  較安全溶劑丙二醇單甲醚醋酸酯PGMEA

NextStep
Ready for NextStep

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

ALLRESIST

Property I

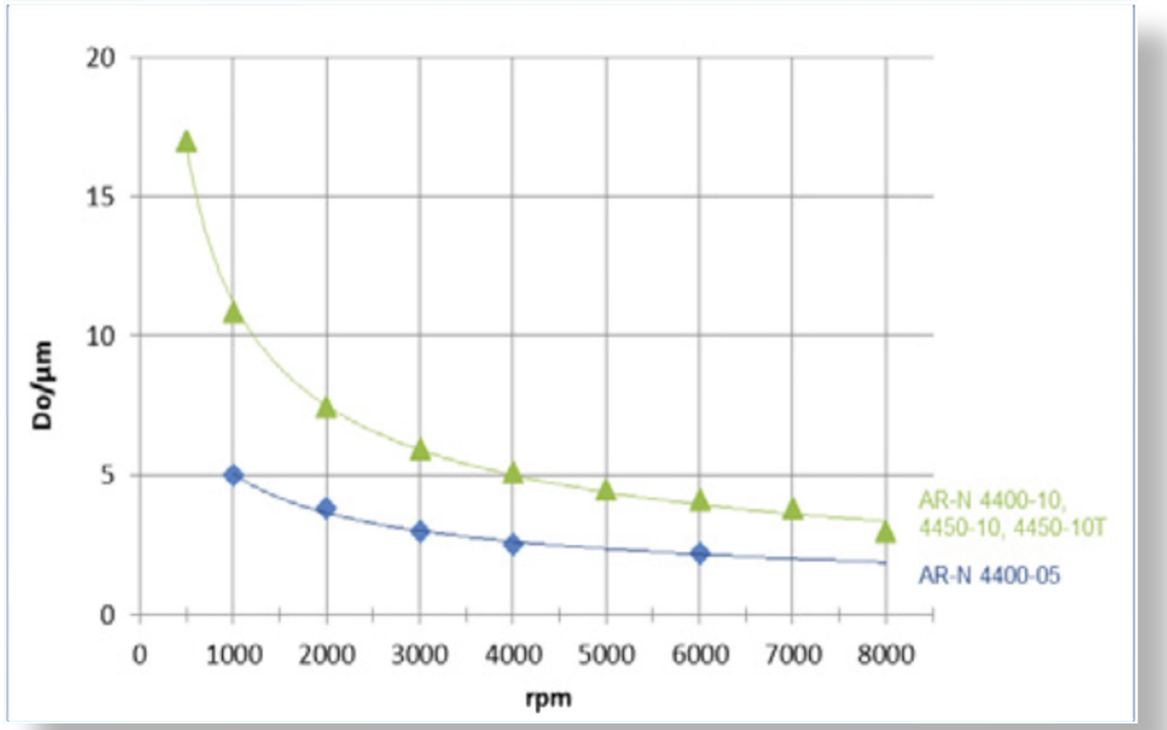
		Film Thickness ≦ 20 um			Film Thickness ≧ 50 um	
Parameter		AR-N 4400-05	AR-N 4400-10	AR-N 4450-10T	AR-N 4400-25	AR-N 4400-50
Solids content 固型份	%	33	45	41	52	58
Film thickness@1000rpm	um	5	10	10	25	50
Resolution 解析度	um	1.0	2.0	3.5	3.5	5.0
Contrast 對比		4.0	4.0	10	5.0	6.0
Flash point 閃火點	℃	46				
Storage 6 months	℃	10 - 18				

Property II

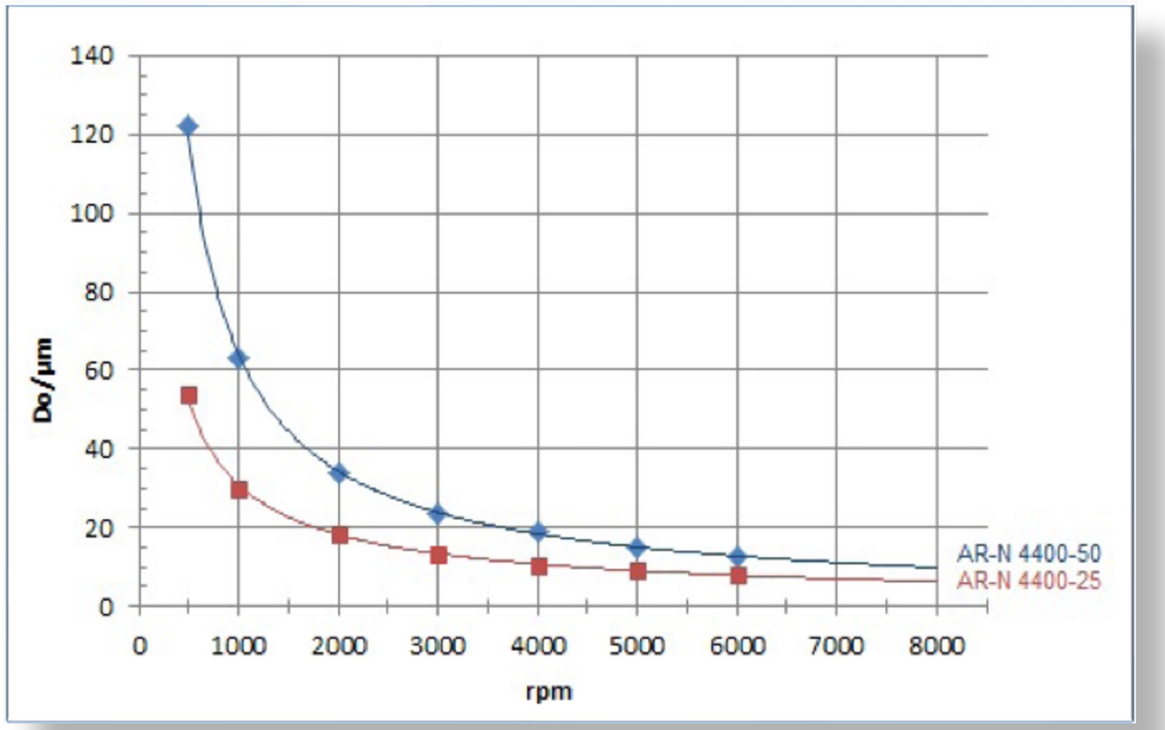
Glass trans. temperature	℃	102	
Dielectric constant		3.1	
Cauchy coefficients	N_0	1.615	
	N_1	77.6	
	N_2	64.1	
Plasma etching rate 5 Pa, 240-250 V Bias	nm/min	Ar-sputtering	3
		O_2	122
		CF_4	31
		80 CF_4 + 16O_2	81

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

Spin curve of AR-N 4400-05/10/10T



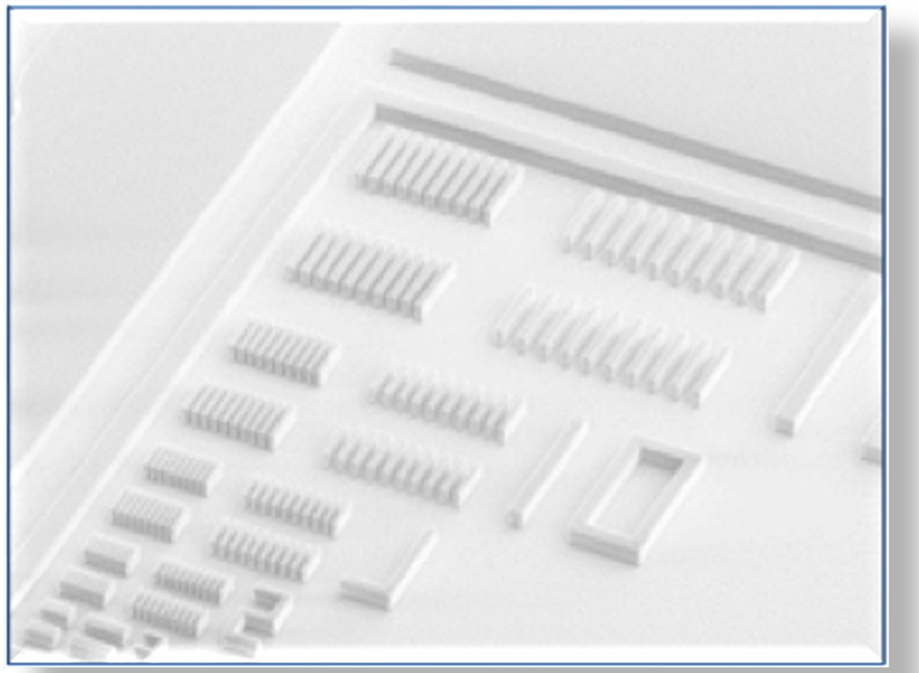
Spin curve of AR-N 4400-25/50



Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

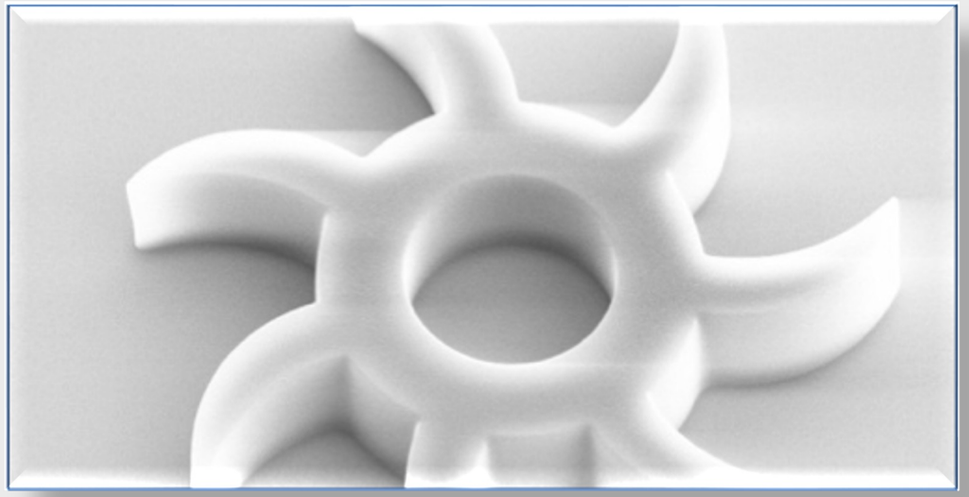
Resist structures

AR-N 4400-10 3 µm resolution at a film thickness of 15 µm



Resist structures

Turbine wheel produced with AR-N 4400-10



Process parameters

Substrate	Si 4” wafer
Soft-bake	95 °C x 10 min, hot plate
Exposure	Mask aligner MJB 3, contact exposure
Development	AR 300-47pure, 3 min, 22°C

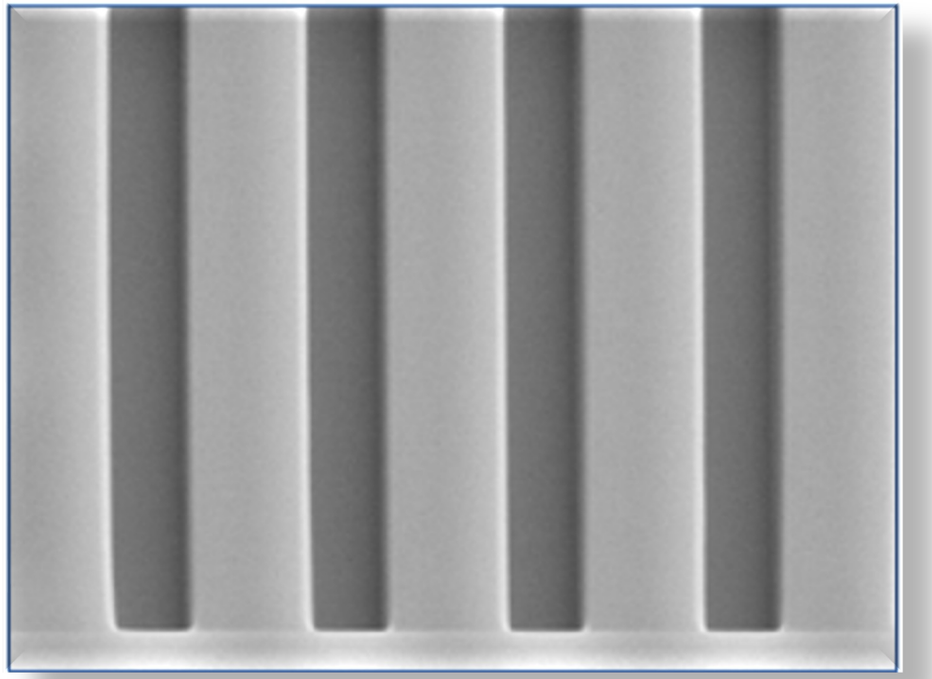
Process chemicals

Adhesion promoter	AR 300-80
Developer	AR 300-47, AR 300-44
Thinner	AR 300-12
Remover	AR 600-71, AR 600-70

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

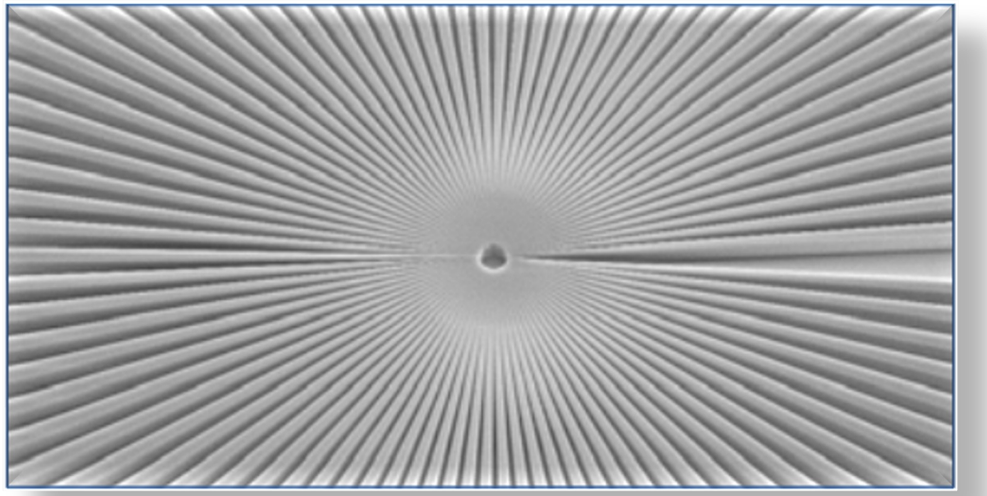
Resist resolution

AR-N 4400-25 5 µm trenches at a film thickness of 40 µm



Resist structures

Siemens star produced with AR-N 4400-25 (30 µm thickness)



Process parameters

Substrate	Si 4” wafer
Soft-bake	95 °C x 10 min, hot plate
Exposure	Mask aligner 150
Development	AR 300-44pure, 90 min, 22°C

Process chemicals

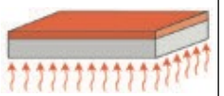
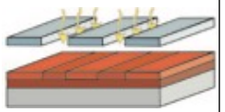
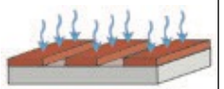
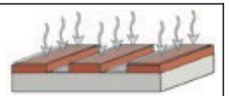
Adhesion promoter	AR 300-80
Developer	AR 300-46, AR 300-44
Thinner	AR 300-12
Remover	AR 600-71, AR 600-70

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

Process baseline

This diagram shows exemplary process steps for resist AR-N 4400series resist. 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 4400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

		AR-N 4400-05	AR-N 4400-10	AR-N 4400-25	AR-N 4400-50	AR-N 4450-10T
Coating (open chuck) 		5 um@1000rpm	10 um@1000rpm	25 um@1000rpm	50 um@1000rpm	10 um@1000rpm
Soft bake H*: hot plate C*: convection oven 	H*	90°C x 4 min	90°C x 15 min	90°C x 30 min	90°C x 90 min	90°C x 15 min
	C*	85°C x 30 min	85°C x 60 min	84°C x 2 hour	85°C x 3 hour	85°C x 60 min
UV exposure 		Mask aligner, broadband UV/Exposure dose (E_0 broadband UV)				
		22 mJ/cm^2	26 mJ/cm^2	33 mJ/cm^2	52 mJ/cm^2	95 mJ/cm^2
Cross-linking bake (± 1°C) 	H*	100°C x 5 min	100°C x 10 min	100°C x 10 min	100°C x 10 min	100°C x 10 min
	C*	95°C x 30 min	95°C x 40 min	95°C x 60 min	95°C x 80 min	95°C x 40 min
Development (21-23±0.5°C) puddle 		AR 300-47	AR 300-47	AR 300-46	AR 300-44	AR 300-44
		1 min	4 min	9 min	18 min	3 min
Rinse		DI water, 30 sec and dry with caution				
Hardening of structures up to 300°C(optional)		Flood exposure 100mJ/cm^2; bake 120°C, 5 min hot plate				
Customer specific technology 		Generation of e.g., semiconductor properties or lift-off (4450-10T) and galvanic, MEMS				
Removal 		AR 300-76 for low crosslink density, AR 600-71 for high crosslink density. O2 plasma ashing is also possible for high film thicknesses.				

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

Reference data for process tuning

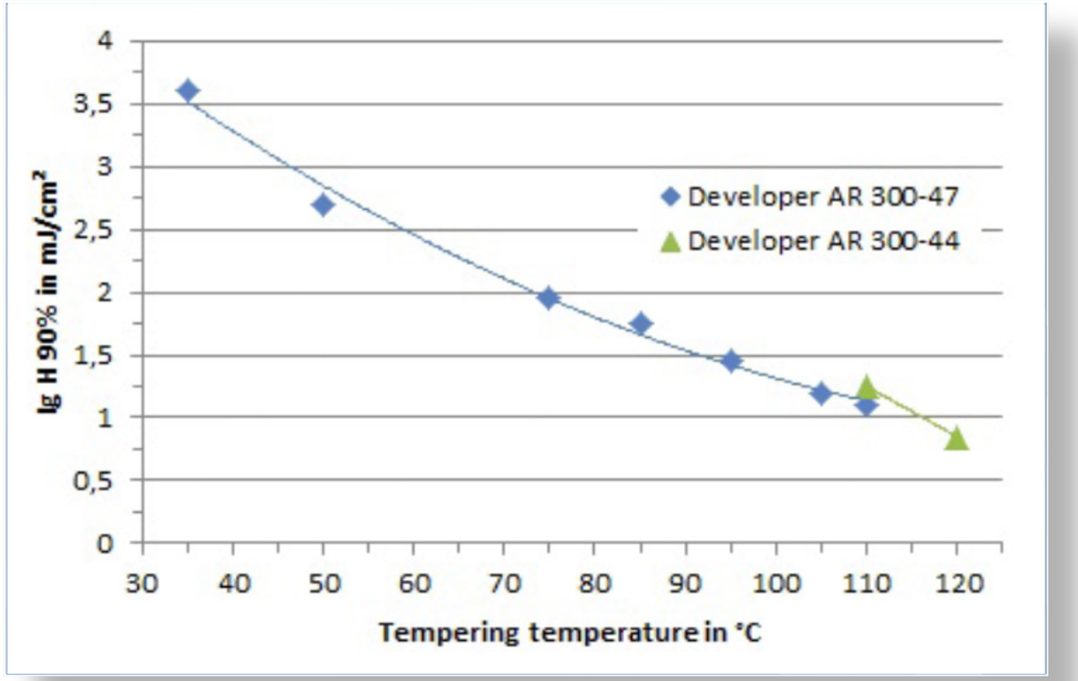
Development recommendations

Developer	Resist				
	AR-N 4400-05 3 – 10 um	AR-N 4400-10 5 – 20 um	AR-N 4400-25 13 – 25 um	AR-N 4400-50 25 – 100 um	AR-N 4450-10T 5 – 20 um
AR 300-44	- -	- -	- -	8 : 1 to undilute	undilute
AR 300-46	- -	- -	5 : 1 to undilute	undilute	- -
AR 300-47	6 : 1 to undilute	3 : 2 to undilute	undilute	- -	- -
AR 300-475	undilute	- -	- -	- -	- -

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

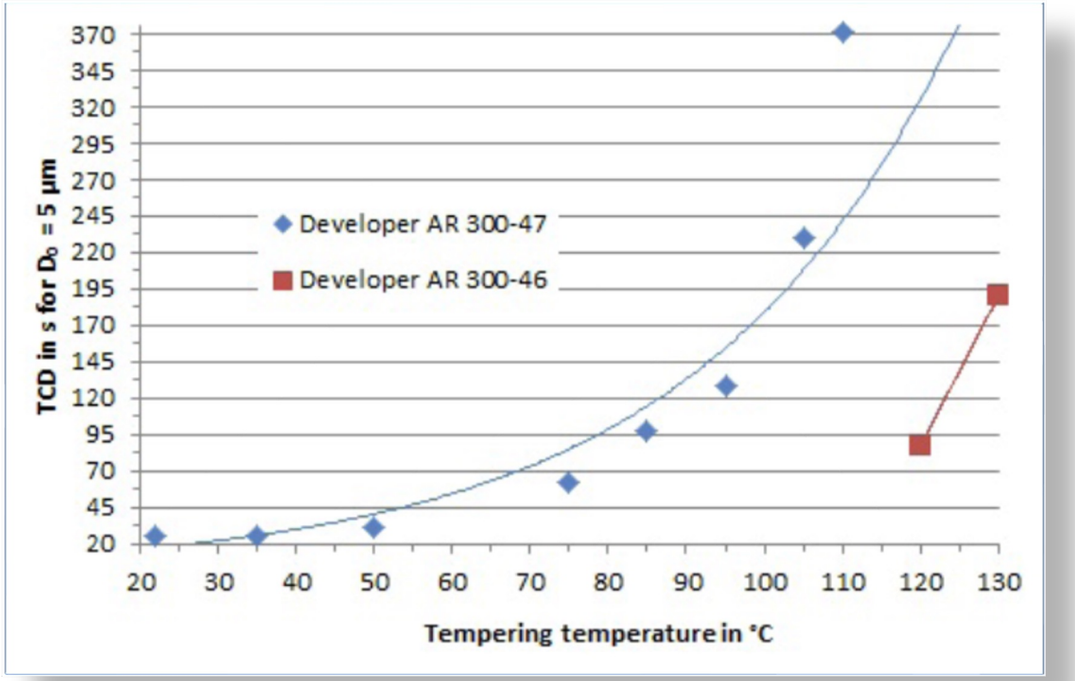
Reference data for process tuning

Sensitivity of AR-N 4400-05



The sensitivity increases constantly with increasing bake temperatures (broadband UV Mask aligner, thickness 5.0 µm)

Time for complete development of AR-N 4400-05

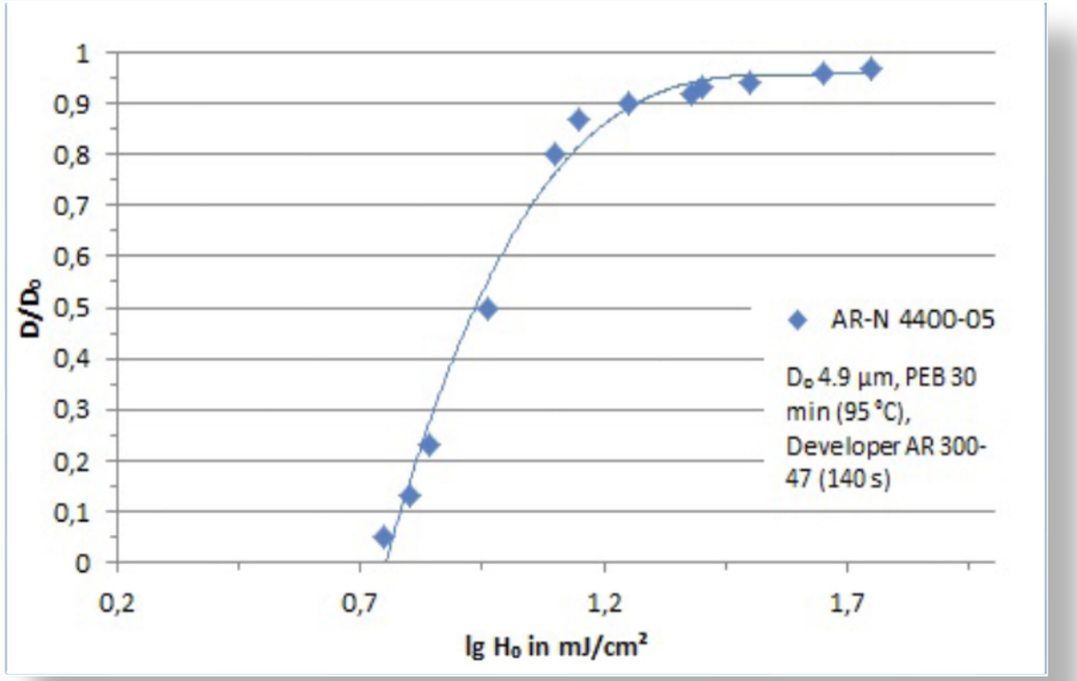


With increasing temperature, the TCD increases considerably. > 130 °C, no development is possible even if strong developers (AR 300-44) are used.

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

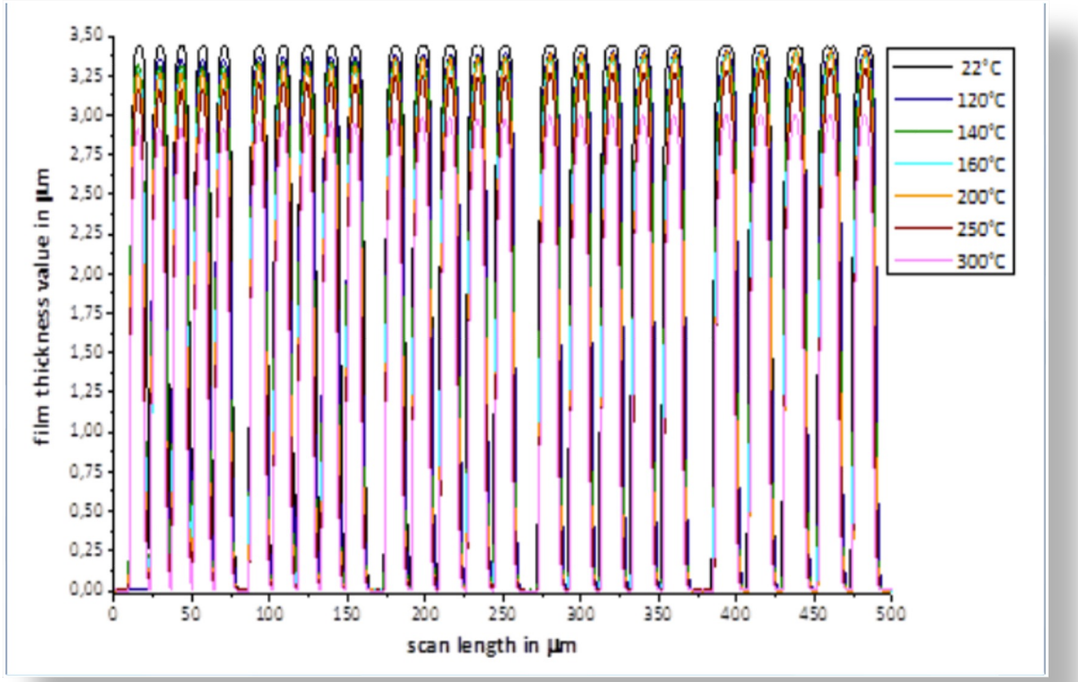
Reference data for process tuning

Gradation curve of AR-N 4400-05



The gradation (contrast) is 3.5, the sensitivity was determined to 21.5 mJ/cm^2 for a structure buildup of 90 % ($H_0$90).

Thermal stability and shrinking up to 300 ˚C

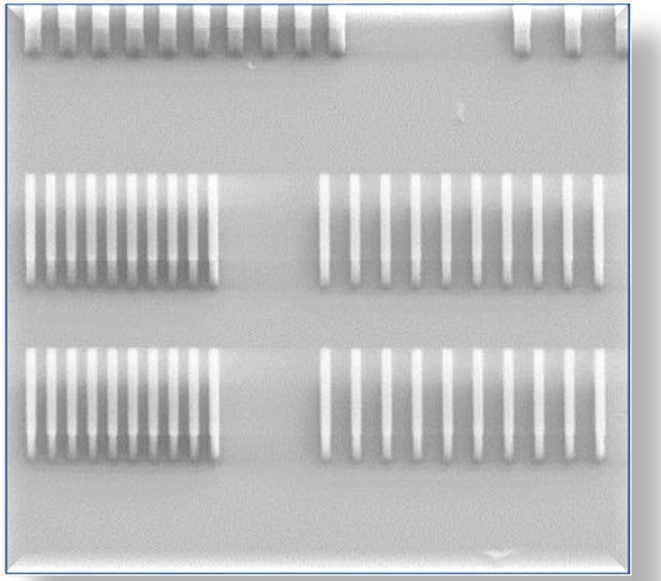


Developed lines with a width of 10 – 20 µm were hardened by flood exposure and subsequent bake step. These lines were tempered stepwise until 300 ˚C. Up to a temperature of 200 ˚C, structures remain more or less un-changed.

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

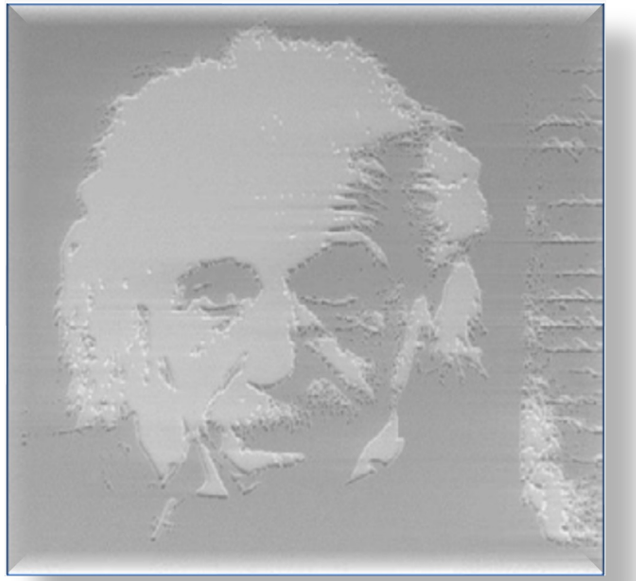
Reference data for process tuning

Resolution of AR-N 4400-05



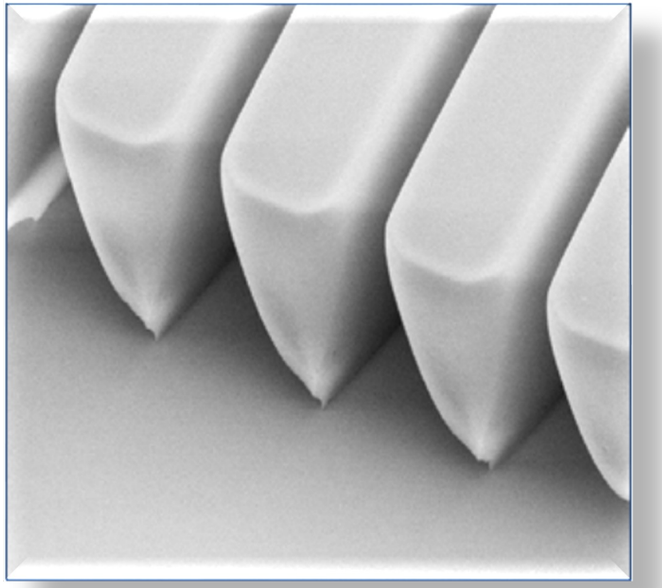
At a film thickness of 5 µm, 1.0 µm bars were produced

Picture of Albert Einstein



Test structure produced on the occasion of the “Einsteinjahr” in 2006

Lift-off structures



Undercuts produced with low exposure dose (AR-N 4450-10T)

Processing instructions for the handing of thick films

Coating:

In order to avoid the formation of bubbles, the resist should be left undisturbed for at least one day prior to processing. For resist with higher viscosity from AR-N 4400-25 onwards, degassing with ultra- sound or vacuum is advisable.

The resist should be applied slowly, from a low height and always using the same amount of resist (e.g., 100 ml for 4-inch-wafers) onto the standing wafer. Subsequently, a formation for 10 s a low rotational speed (250 - 400 rpm) is recommended, followed by slow increase of the spin speed up to the desired final speed. To achieve a high resist film quality, rotational speeds above 2000 rpm should be avoided for the highly viscous AR-N 4400-50.

👉 Shorter coating times at final spin speed will increase the film thickness.
Multiple coating steps (up to 4 x) are possible for film thicknesses between 50 and 150 µm. A particularly high edge steepness of structures results in this case from an improved drying procedure. After each coating step, the resist is dried at 85 °C (hot plate) or 90 °C (convection oven) according to the specifications as given in the process conditions.

塗佈：

為避免氣泡形成,塗佈前光阻應先靜置至少一天. 高黏度光阻,例如AR-N 4400-25以上,建議以超音波或真空脫氣.
光阻滴膠應儘量接近基板,滴膠速度不要太快且保持定量. 例如: 定量100ml於4寸晶圓. 滴膠先以低轉速(約250 – 400rpm)讓膠膜成型,再依厚度需要,逐步增加轉速. 高黏度光阻,例如AR-N 4400-50,為維持厚膜品值,應避免轉速超過2,000 rpm.
減少主轉速塗佈時間,可提高膜厚.
介於50 – 150 um的高膜厚可以多次塗佈達成. 改善軟烤程序可讓高膜厚光阻圖案邊緣垂直度增加. 如前製程基本參數所述:在各個塗佈程續後以 85°C(熱板)或90°C對流烤箱對光阻軟烤.

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

Processing instructions for the handing of thick films

Tempering: The required tempering times are highly dependent on the respective film thickness:

thickness	dry time(hot plate)	drying time(convection oven)
10 um	10 min	1 hour
25 um	45 min	4 hour
50 um	90 min	7 hour

The use of temperature ramps is highly recommended, since too fast cooling may lead to tension cracks.
👉 Long intensive drying procedures result in decreased sensitivities and prolonged development times.

軟烤：軟烤的時間與光阻厚度有直接關係:

厚度	時間(熱板)	時間(對流烤箱)
10 um	10 min	1 hour
25 um	45 min	4 hour
50 um	90 min	7 hour

建議階梯式升降溫以避免光阻冷卻過快導致應力破裂.長時間,高強度乾燥會降低敏感度及拉長顯影時間

Cross-linking: The crosslinking temperature can be varied in the range from 85 ˚C to 105 ˚C. The bake can be performed a few days after exposure without loss of sensitivity. 👉Higher temperatures lead to a slower development.

架橋:
光阻架橋溫度介於85°C至105°C之間. 此程序於執行曝光後幾天內,不至於降低其敏感度. 高溫架橋(曝後烤)會導致顯影變慢.

Development:
longer development times with weaker developer provide a higher imaging quality. For AR-N 4450-10T, the undercut (lift-off) of resist structures can be achieved by extending the development time at the minimum required exposure dose.
顯影: 以較弱顯影劑拉長顯影時間可得到較佳圖案品值. AR-N 4450-10T以低劑量曝光並拉長顯影時間可獲得下切型結構

Removal: Crosslinked structures can easily be removed by wet- or plasma chemical procedures using removers AR 600-71 and AR 300-76. Complicated electroplating structures as well as substrates treated with high temperatures require removers AR 600-71 or AR 600-70.
光阻去除: 光阻經架橋後形成的結構可以去除劑AR 600-71, AR 300-76或電漿去除. 基板上的光阻結構用於金屬電鍍則需AR 600-71或AR 600-70去除劑.

Negative thick layer photoresist AR-N 4400 series (CAR 44)
For the application of electroplating, micro-system and LIGA

Comparison CAR 44 and Sx-x		
CAR 44	Resist properties – Suitability 光阻物性-適用性	Sx-x
✅	thick films 厚膜光阻特性	✅✅
✅	high resolution 解析度	✅
✅	excellent aspect ratio 深寬比	✅
✅	high sensitivity at i-line, deep UV, e-beam, X-ray 各類光源曝光敏感度	✅✅
✅	good sensitivity at g-line g線波長曝光敏感度	❎
✅	low-stress tempering – easy handling 低熱應力-製程控制性	❎
✅	aqueous-alkaline development 鹼性水溶液顯影	❎
✅	easy removal 光阻去除性	❎