AZ 5214 E

Image Reversal
Photoresist

Clariant

GENERAL INFORMATION

This special photoresist is intended for lift-off-techniques which call for a negative wall profile. Although they are positive photoresists (and may even be used in that way) comprised of a novolak resin and naphthoquinone diazide as photoactive compound (PAC) they are capable of image reversal (IR) resulting in a negative pattern of the mask. In fact AZ 5214E is almost exclusively used in the IR-mode.

The image reversal capability is obtained by a special crosslinking agent in the resist formulation which becomes active at temperatures above 110°C and - what is even more important - only in exposed areas of the resist. The crosslinking agent together with exposed PAC leads to an almost insoluble (in developer) and no longer light sensitive substance, while the unexposed areas still behave like a normal unexposed positive photoresist. After a flood exposure (no mask required) this areas are dissolved in standard developer for positive photoresist, the crosslinked areas remain. The overall result is a negative image of the mask pattern.

As everybody knows a positive photoresist profile has a positive slope of 75 - 85° depending on the process conditions and the performance of the exposure equipment (only submicron-resists get close to 90°). This is mainly due to the absorption of the PAC which attenuates the light when penetrating through the resist layer (so called bulk effect). The result is a higher dissolution rate at the top and a lower rate at the bottom of the resist. When AZ 5214E is processed in the IR-mode this is reversed as higher exposed areas will be crosslinked to a higher degree than those with lower dose, dissolution rates accordingly. The final result will be a negative wall profile ideally suited for lift-off.

The most critical parameter of the IR-process is reversal-bake temperature, once optimised it must be kept constant within ± 1°C to maintain a consistent process. This temperature also has to be optimised individually. In any case it will fall within the range from 115 to 125°C. If IR-temperature is chosen too high (>130°C) the resist will thermally crosslink also in the unexposed areas, giving no pattern. To find out the suitable temperature following procedure is suggested:

Coat and prebake a few substrates with resist. Without exposing them to UV-light subject them to different reversal-bake temperatures, i.e. 115°, 120°, 125° and 130°C. Now apply a flood exposure of > 200mJ/cm² and afterwards immerse them into a standard developer make up, i.e. AZ 351B, 1:4 diluted, or AZ 726 MIF for 1 minute. From a part of the substrates the resist will be removed, another part (those exposed to a too high temperature) will remain with the resist thermally crosslinked on it. Optimum RB-temperature now is 5° to 10°C below the temperature where crosslinking starts.

The flood exposure is absolutely uncritical as long as sufficient energy is applied to make the unexposed areas soluble. 200 mJ/cm² is a good choice, but 150 - 500 mJ/cm² will have no major influence on the performance.

Finally it should be noted that the imagewise exposure energy is lower than with normal positive processes, generally only half of that. So a good rule of thumb is: compared to a standard positive resist process, imagewise exposure dose should be half of that, flood exposure energy double of that for AZ 5214E IR-processing.

Once understanding and being familiar with this IR-procedure it is quite simple to set up a different process for lift-off. A T-shaped profile can be achieved by the following process sequence:

The prebaked AZ 5214E photoresist is flood exposed (no mask) with a small amount of UV energy, just to generate some exposed PAC at the surface. Now the reversal-bake is performed to partially crosslink this top areas. By this treatment a top layer with a lowered dissolution rate compared to the bulk material is generated. After this the resist is treated like a normal positive photoresist (imagewise exposure and development) to generate a positive image! Due to the lower dissolution rate in the top layer a T-shaped profile with overhanging lips will be the result.

PHYSICAL and CHEMICAL PROPERTIES

		AZ 5214E	
Solids content [%]		28.3	
Viscosity [cSt at 25°C]		24.0	
Absorptivity [l/g*cm] at 377nm		0.76	
Solvent	methoxy-propyl acetate (PGMEA)		
Max. water content [%]	0.50		
Spectral sensitivity	310 - 420 nm		
Coating characteristic	striation free		
Filtration [µm absolute]	0.1		

FILM THICKNESS [µm] as FUNCTION of SPIN SPEED (characteristically)

spin speed [rpm]	2000	3000	**4000**	5000	6000
AZ 5214E	1.98	1.62	**1.40**	1.25	1.14

PROCESSING GUIDELINES

Dilution and edge bead removal	AZ EBR Solvent
Prebake	110°C, 50", hotplate
Exposure	broadband and monochromatic h- and i-line
Reversal bake	120°C, 2 min., hotplate (most critical step)
Flood exposure	> 200 mJ/cm² (uncritical)
Development	AZ 351B, 1:4 (tank, spray) or AZ 726 (puddle)
Postbake	120°C, 50s hotplate (optional)
Removal	AZ 100 Remover, conc.

HANDLING ADVISES

Consult the **Material Safety Data Sheets** provided by us or your local agent!
This AZ Photoresists are made up with our patented safer solvent PGMEA. They are **flammable liquids** and should be kept away from oxidants, sparks and open flames.
Protect from light and heat and store in sealed original containers between 0°C and 25°C, exceeding this range to -5°C or +30°C for 24 hours does not adversely affect the properties.
Shelf life is limited and depends on the resist series. The **expiration date** is printed on the label of every bottle below the batch number and coded as **[year/month/day]**.
AZ Photoresists are compatible with most commercially available wafer processing equipment. **Recommended materials** include PTFE, stainless steel and high-density poly-ethylene and -propylene.

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