Technical datasheet

AZ® BARLi™ II

Bottom Anti-Reflective Coatings

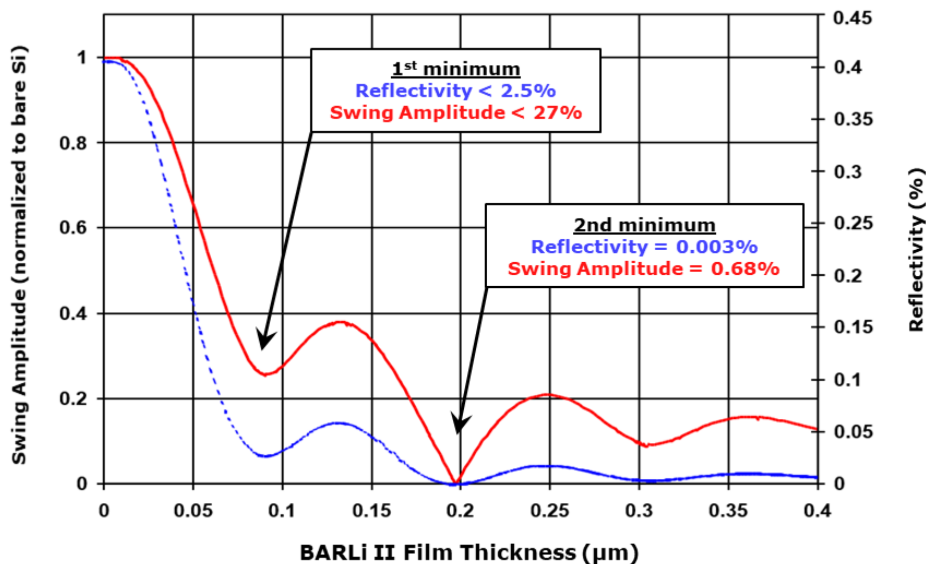
APPLICATION

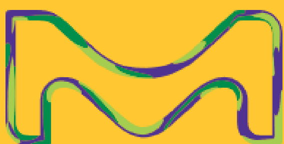
AZ® BARLi II Coatings are unique organic bottom anti-reflective layers formulated with polymer bound dyes and no monomeric chromophores. Unlike other spin-on BARC materials, the polymer bound dye design of AZ BARLi II virtually eliminates the equipment maintenance and particle defect issues associated with dye sublimation during thermal cure.

- Optimum n and k for i-line lithography
- Eliminates CD variation due to thin film interference effects
- Eliminates reflective notching defects
- High dry etch selectivity to photoresist (>1.4)
- Significantly improves substrate adhesion (no HMDS required)
- Easily removed using common photoresist strippers

TYPICAL PROCESS

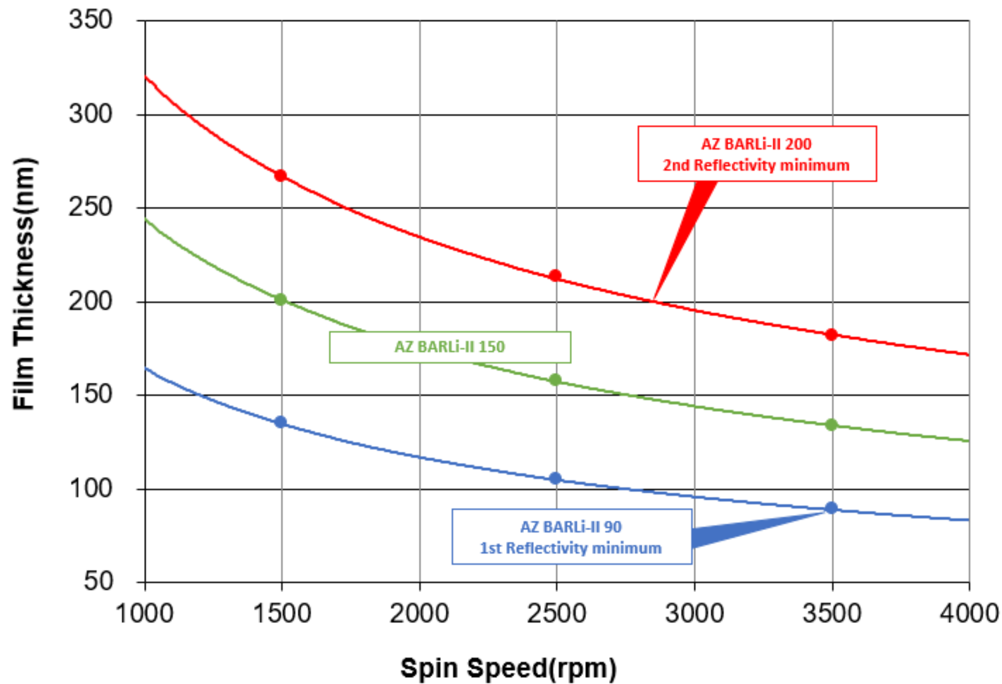
- Spin coat to 1st or 2nd reflectivity minimum (900Å or 1920Å)
- Edge bead removal (EBR 70/30)
- Cure for 60 seconds at 180°C– 200°C
- Coat and pattern photoresist
- Dry etch BARLi II layer





THICKNESS GRADES AND SPIN CURVES

AZ BARLi II is available in two thickness grades (90nm and 200nm) for easy targeting of film thicknesses at the first or second reflectivity minimum.



BARLi II FILM THICKNESS MEASUREMENT AND OPTICAL MODELING

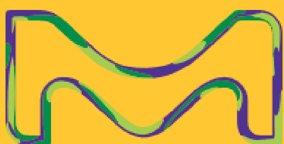
Film Thickness Measurement*

Cauchy A	**1.6097**
Cauchy B (μm^2)	**0.0083014**
Cauchy C (μm^4)	**0.006187**

3 Layer Reflectivity Modeling @ 365nm

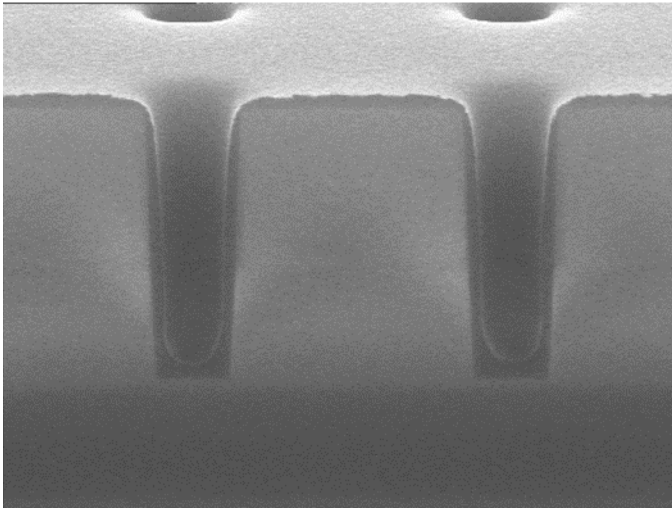
Photoresist (typ.)	**n = 1.70 – 0.024i**
BARLi II	**n = 1.63 – 0.31i**
Si	**n = 6.55 - 2.07i**

* Do not use incident wavelengths below 500nm when measuring the thickness of BARLi films. Wavelengths below 500nm fall into the anomalous region of refractive index dispersion curve. Erroneous film thickness results will be reported.



CONFORMAL COATING PERFORMANCE

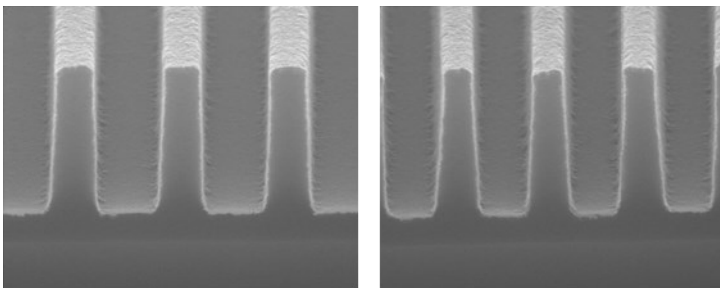
Conformal coating of substrate topography is an important feature of spin-on BARC materials as reflectivity is a strong function of film thickness. AZ BARLi II coatings are formulated to cover topography uniformly for minimal variation in reflectivity.



AZ BARLi II coated over high aspect ratio substrate topography (> 4:1)

PHOTORESIST COMPATIBILITY

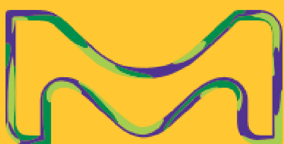
Cured BARLi II films are chemically inert and exhibit excellent compatibility with all standard DNQ type photoresists.



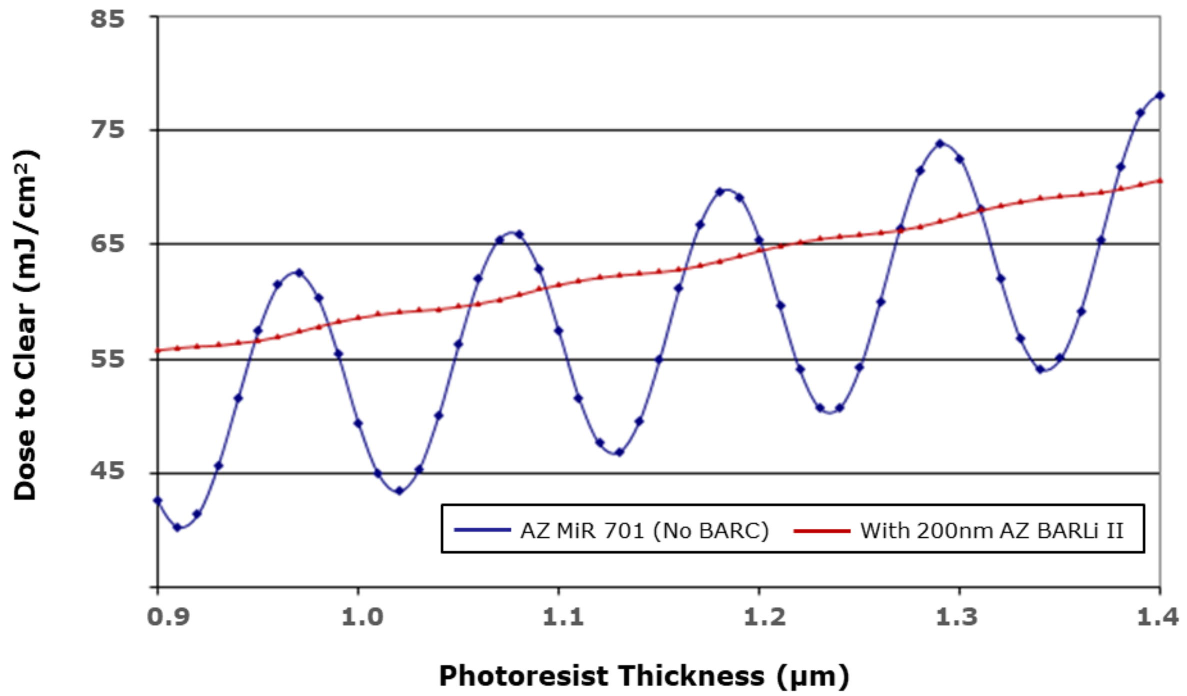
0.36µm 0.32µm

0.36µm and 0.32µm lines in AZ 7908 i-line photoresist on 200nm AZ BARLi II film.

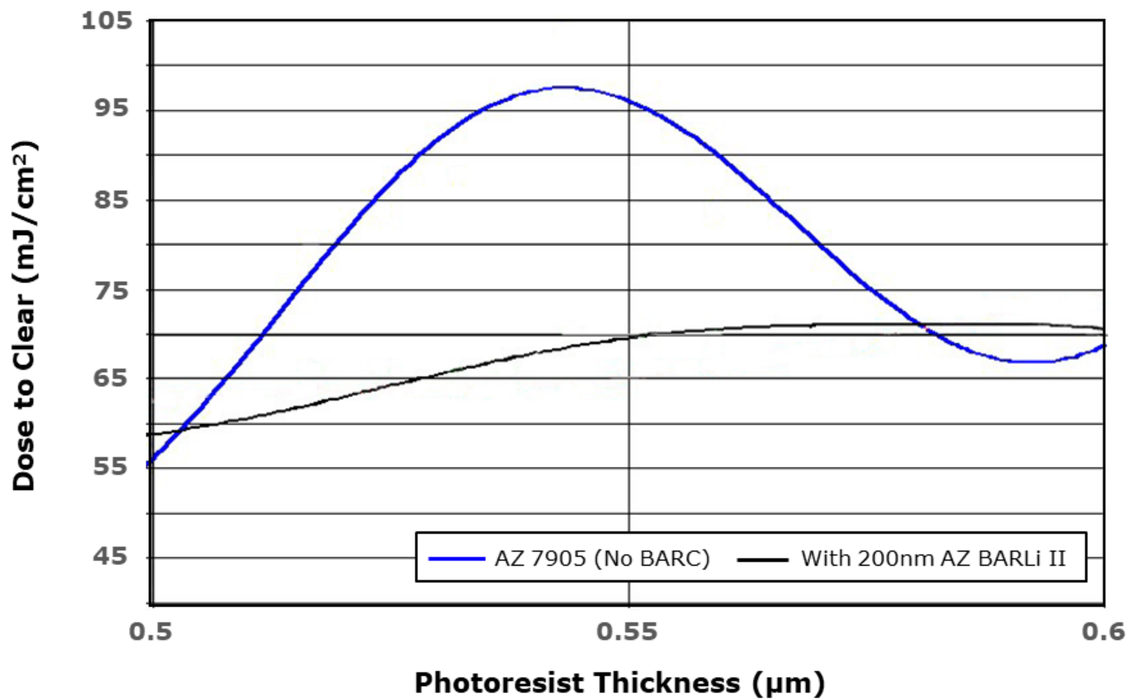
Dense lines on AZ BARLi II
BARC Bake: 60s @ 200°C
Exposure: 0.54NA Nikon Stepper
Develop: AZ 300MIF, 60s puddle

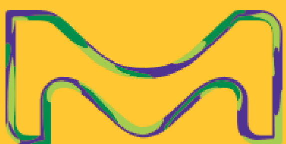


BARLi II SWING AMPLITUDE SUPRESSION IN AZ MIR 701 PHOTORESIST

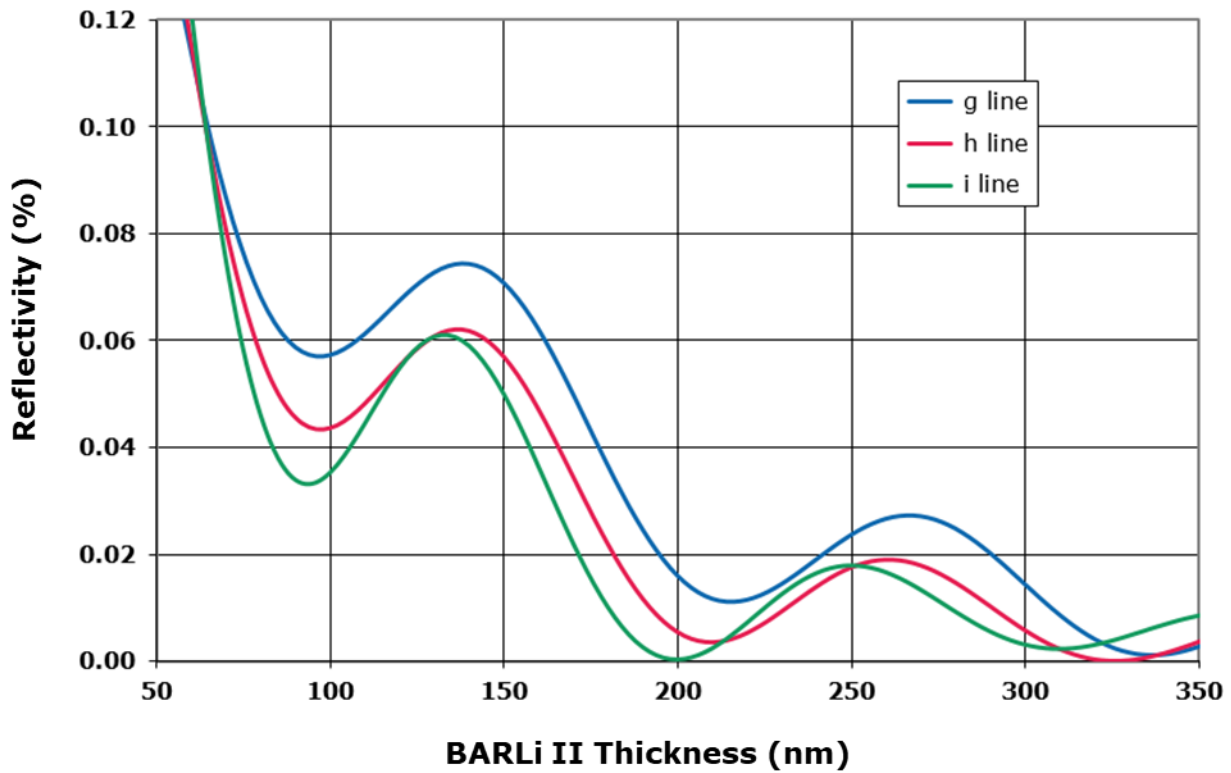


BARLi II SWING AMPLITUDE SUPRESSION IN AZ 7905 PHOTORESIST

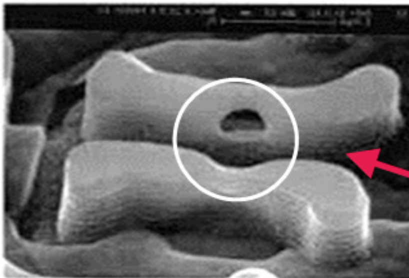




REFLECTIVITY INTO RESIST AT 365, 405, AND 435NM EXPOSURE WAVELENGTHS

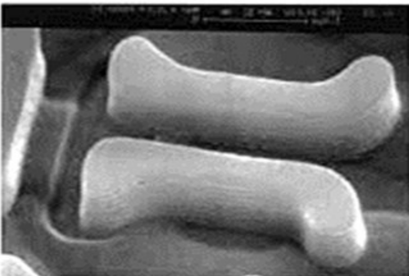


REFLECTIVE NOTCHING SUPRESSION WITH AZ BARLi II



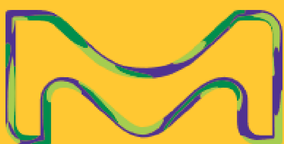
Transistor gate structures imaged on reflective poly silicon topography with no BARC.

Oblique reflections from substrate topography cause notching damage to the photoresist pattern.



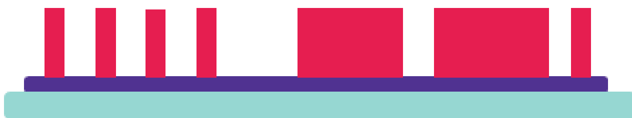
Same transistor gate structures imaged on reflective poly silicon topography with 2000A BARC layer.

Notching damage is eliminated via suppression of substrate reflectivity.

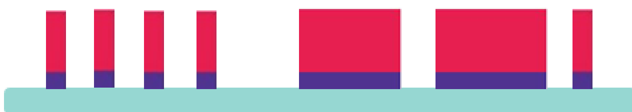


AZ BARLi II PROCESS FLOW

- Spin coat BARLi II (no HMDS required)
- Remove edge bead AZ EBR 70/30)
- Bake 60s @ 180-200°C

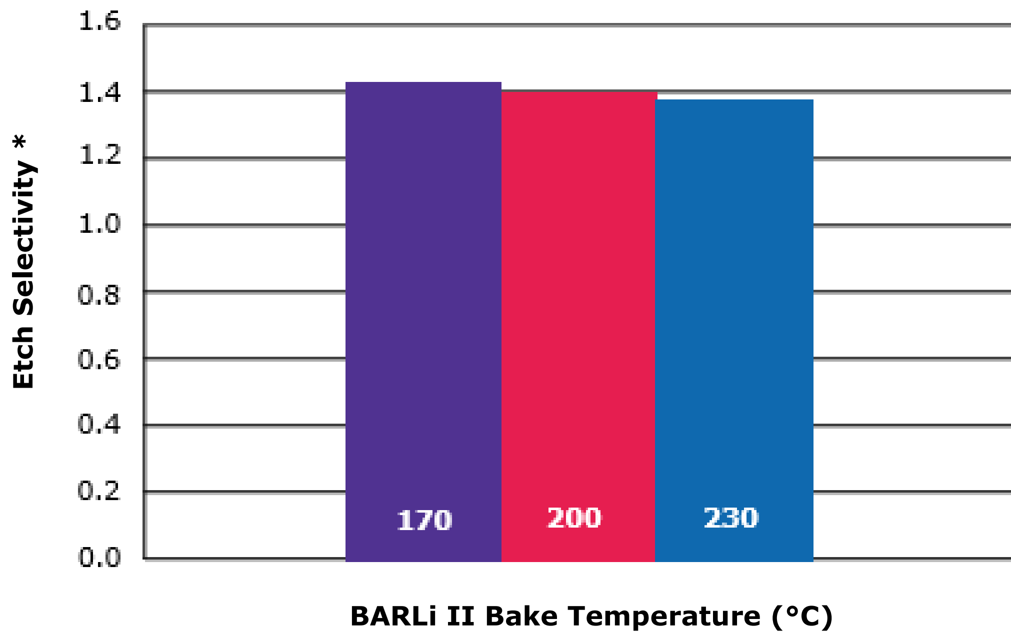


- Coat and Pattern Photoresist
- Develop stops on BARLi II layer

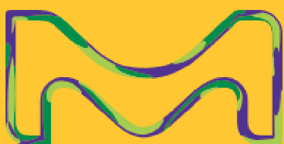


- Transfer photoresist pattern into BARLi II layer via dry etch.
- BARLi II is removed with photoresist

AZ BARLi II ETCH SELECTIVITY TO I-LINE RESIST VS. BAKE TEMPERATURE



* Etch Process: Samco RIE-10N, CHF_3 (40sscm), O2 (10sscm), 60W, 60s



PROCESS CONSIDERATIONS

SUBSTRATE PREPARATION

Substrates must be clean, dry, and free of organic residues. HMDS priming is not required when coating AZ BARLi II. BARLi II films exhibit exceptional adhesion to nearly all common substrate materials.

COATING

Refer to spin curve graphs for general guidelines on setting spin speeds to achieve the desired film thickness.

EDGE BEAD REMOVAL

Remove edge bead using AZ EBR 70/30.

BAKE

AZ BARLi II layers must be cured above 170°C in order to prevent intermixing with common photoresist solvents. Recommended cure temperature range is 180-200°C.

PHOTORESIST PROCESSING

Imaging photoresist on BARLi II films requires no adjustments to the standard lithography process. Standard settings for resist soft bake, post expose bake, and develop may be used. Dose to size for a given CD will be similar to the nearest local maximum on the photoresist's bare silicon CD swing curve.

ETCHING BARLi II

Plasma etch recipes for AZ BARLi II layers are highly dependent upon equipment type and configuration. Experiments to optimize etch rates, selectivity, CD bias, micro-loading etc. must be performed for each individual process environment and equipment set up. In general, BARLi II layers may be etched in-situ with standard polysilicon recipes. BARC etch rates and selectivity to resist may be adjusted by varying the flow rate of O2. Higher O2 flows will increase etch rate of the BARLi II but will also increase resist loss and CD bias.

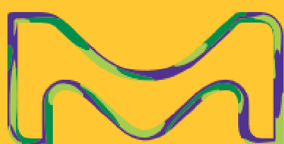
End point detection can be set up using the same wavelength used for the polysilicon layer.

STRIPPING

AZ BARLi II is easily removed during standard wet or dry photoresist strip processes. No extra process steps or specialty remover chemicals are required.

COMPATIBLE MATERIALS

AZ BARLi II Series materials are compatible with all commercially available lithography processing equipment. Compatible materials of construction include glass, quartz, PTFE, PFA, stainless steel, HDPE, polypropylene, and ceramic.



HANDLING/DISPOSAL

AZ BARLi II Series materials contain Ethyl Lactate and PGME (1-Methoxy-2-propanol). Refer to the current version of the MSDS and to local regulations for up to date information on safe handling and proper disposal. Wear solvent resistant gloves, protective clothing, and eye/face protection.

AZ BARLi II is compatible with drain lines handling similar organic solvent based materials.

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