

AZ nLOF 2070 for Electron Beam Lithography

Application Note

Appropriately diluted AZ nLOF 2070 can be used as a chemically amplified negative-tone resist for electron-beam lithography. The material combines aqueous alkaline development with comparatively low exposure doses and supports submicrometre structures in dense lines and complex geometries. This note brings together a legacy 50 keV evaluation and ICS Cardiff application examples exposed at 100 kV (100 keV) in approximately 1.2 μm thick resist.

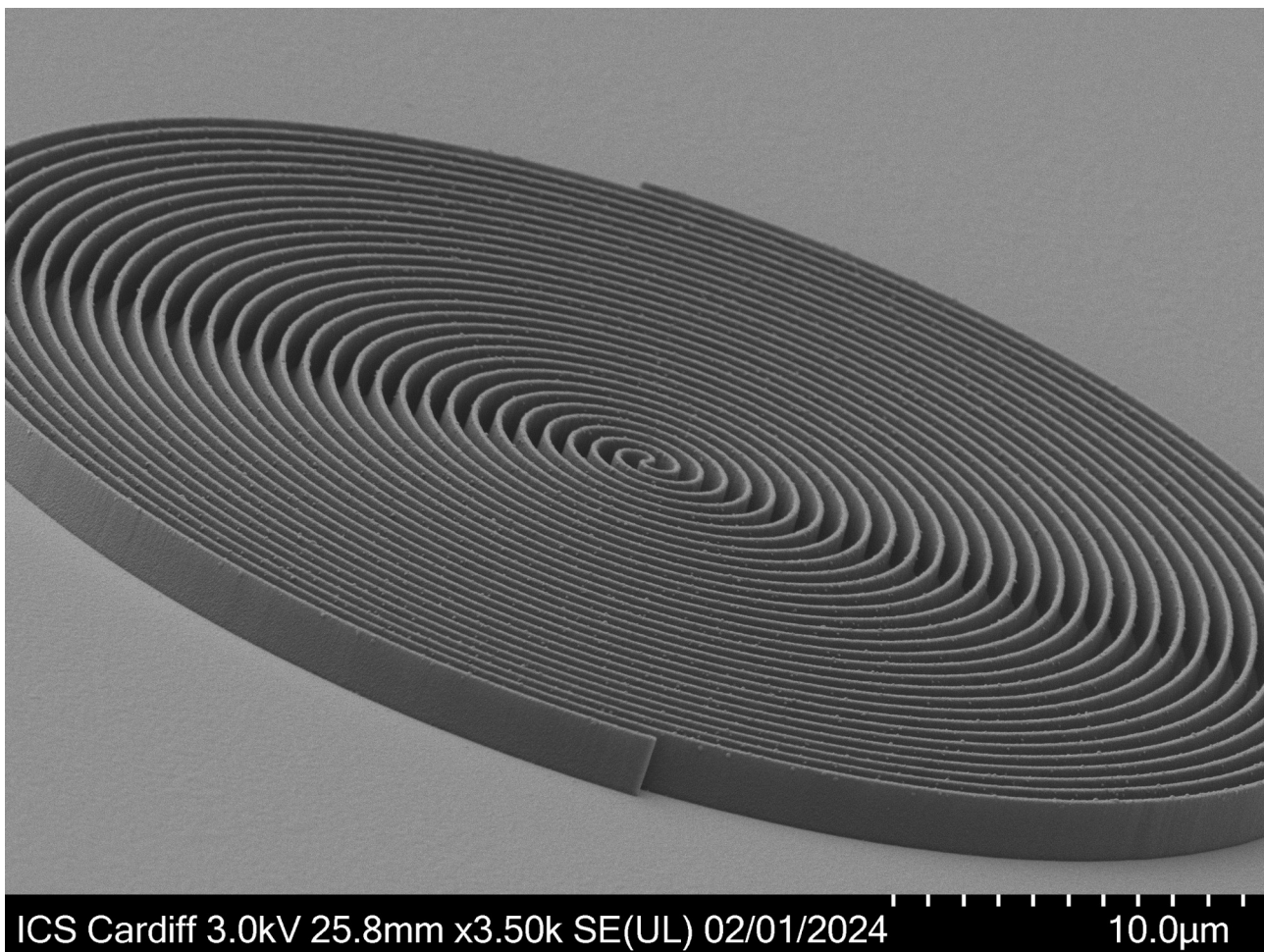


Figure 1 Spiral test structure patterned in diluted AZ nLOF 2070. SEM image courtesy of Dr Tomas Peach, Institute for Compound Semiconductors, Cardiff University. Exposure: 100 kV; resist thickness: approx. 1.2 μm . Gold-coated for SEM imaging.

Process Negative tone	Legacy energy 50 keV	Dense lines 150 nm shown	Cardiff example 131 nm measured
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The reported results are application examples and are not guaranteed product specifications. Users should optimise the process for their substrate, layout and equipment.

Legacy process window

The following conditions and graphs reproduce the earlier 500 nm grade evaluation. They provide a useful starting point, but they do not describe the ICS Cardiff image set shown in Figures 1 and 8 to 12.

Parameter	Reported setting
Substrate	Silicon wafer
Resist thickness	Approx. 545 nm at 4000 rpm before exposure
Resist track	Hamatech Modutrack 2000
Exposure system	Vistec SB352HR with proximity correction
Electron energy	50 keV
Test design	150, 200, 400 and 750 nm dense lines
Developer	AZ 826, double puddle, 2 x 35 s
Coat and exposure delays	0 h
Post-apply bake	100 °C for 60 s
Post-exposure bake	110 °C for 60 s

Spin and contrast data

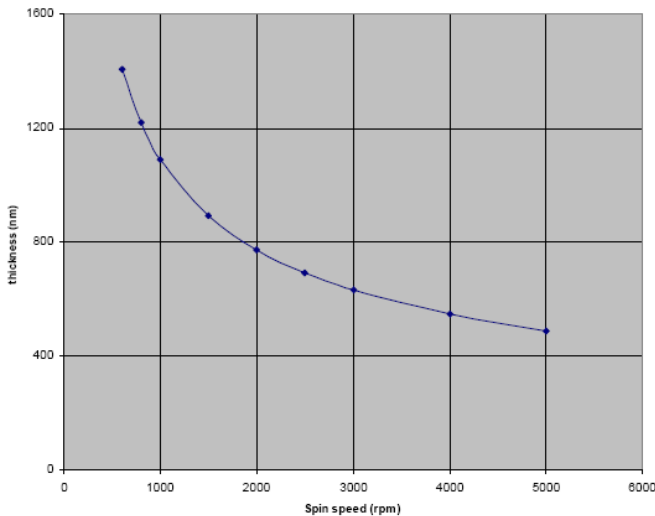


Figure 2 Spin curve from the legacy evaluation.

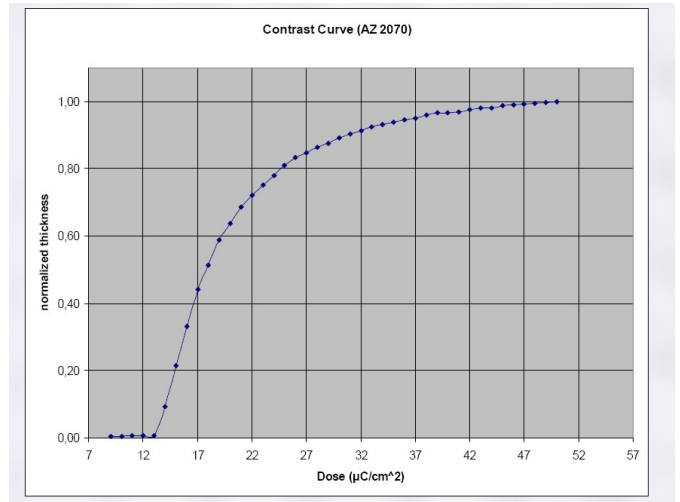


Figure 3 Normalised remaining thickness versus dose.

In the reported process, the contrast curve begins to rise at approximately 13 to 15 $\mu\text{C}/\text{cm}^2$ and approaches a plateau above approximately 40 $\mu\text{C}/\text{cm}^2$. Values should be re-established on the intended tool and substrate.

The ICS Cardiff examples use 100 keV electrons, rather than the 50 keV used in this legacy study. Dr Tomas Peach notes that this higher exposure energy helps explain the higher dose shown in Figure 8 (75.0 $\mu\text{C}/\text{cm}^2$). The dose values should not be compared directly across these different exposure and film-thickness conditions.

Related publication

Peach et al. report a hybrid electron-beam and optical lithography process using the AZ nLOF 2000 family for 150 mm InP ridge lasers. This is a separate application; its process settings are not assigned to the SEM examples in this note.

T. Peach et al., "A Hybrid Electron Beam Lithography Approach to Wafer Scale Up of 150 mm InP Ridge Lasers," IEEE Transactions on Semiconductor Manufacturing, vol. 38, no. 4, pp. 783–789, 2025. DOI: 10.1109/TSM.2025.3601735.

Legacy dense line evaluation

Cross-section SEM images from the 50 keV study show dense line patterns from 750 nm down to 150 nm across the recorded dose series.

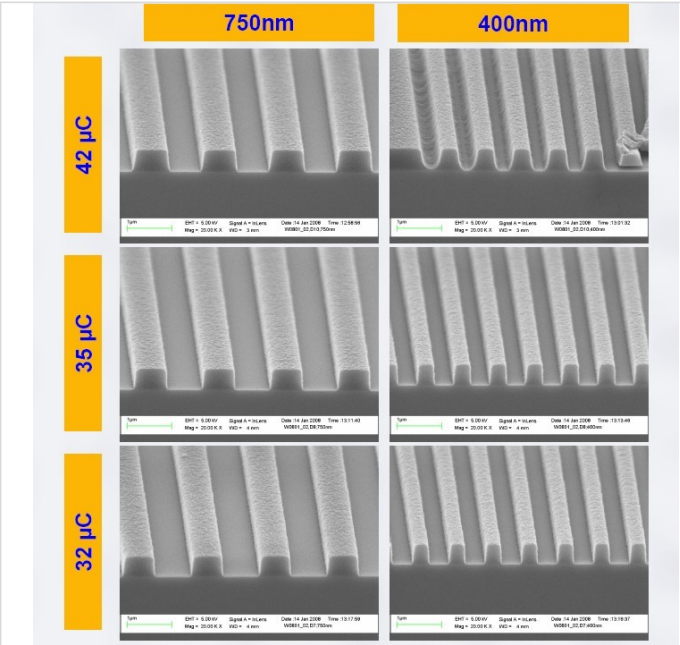


Figure 4 750 and 400 nm lines at 32 to 42 μC as labelled.

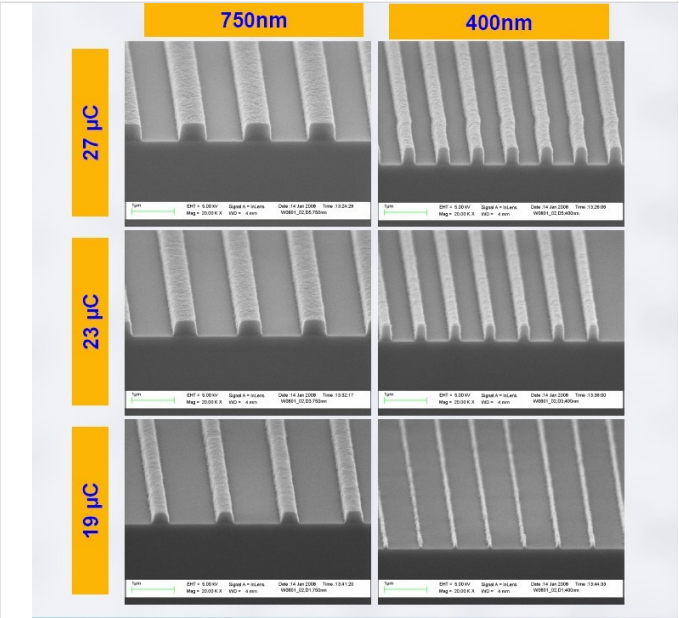


Figure 5 750 and 400 nm lines at 19 to 27 μC as labelled.

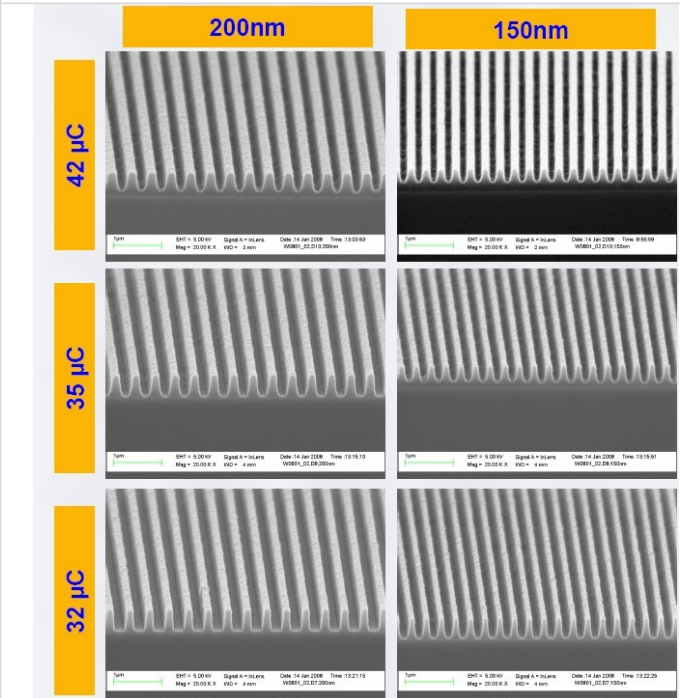


Figure 6 200 and 150 nm lines at 32 to 42 μC as labelled.

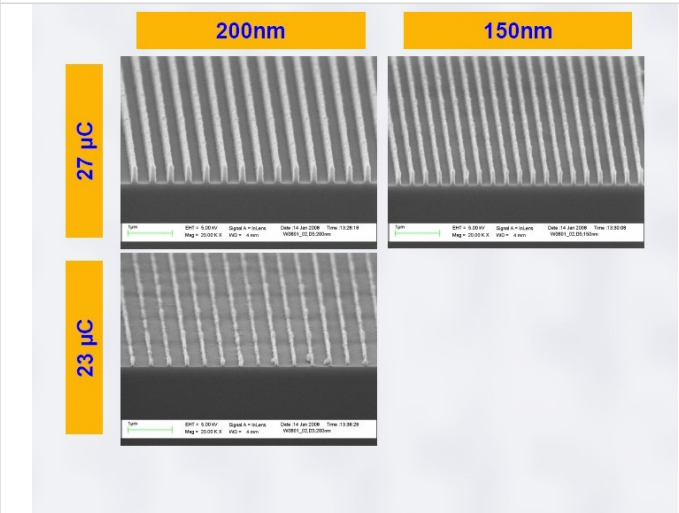


Figure 7 200 and 150 nm lines at 23 to 27 μC as labelled.

Dense line	150 nm	200 nm	400 nm	750 nm
Reported dose factor	1.435	1.401	1.401	1.401

Dose labels and dose factors are reproduced from the original evaluation. The original source did not define the reference dose used for the factor values.

ICS Cardiff application examples

All ICS Cardiff examples on this page and in Figure 1 were exposed at 100 kV (100 keV) in approximately 1.2 μm thick diluted AZ nLOF 2070. The samples were coated with gold for SEM imaging; this coating contributes to the visible surface roughness. The SEM imaging voltage shown in the image footers is not the lithography exposure voltage.

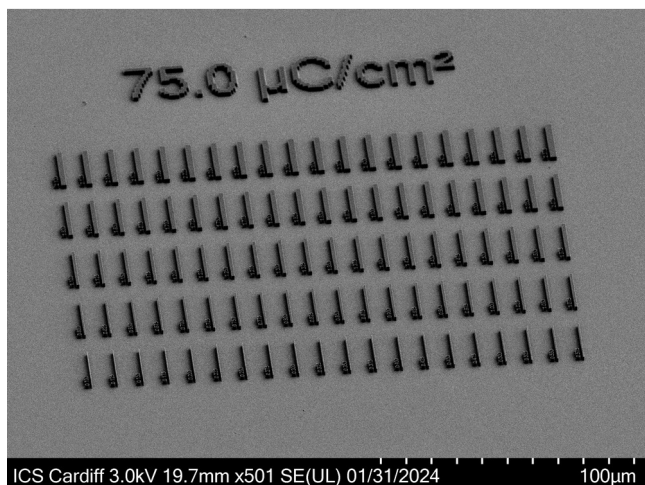


Figure 8 Dose test pattern labelled 75.0 $\mu\text{C}/\text{cm}^2$.

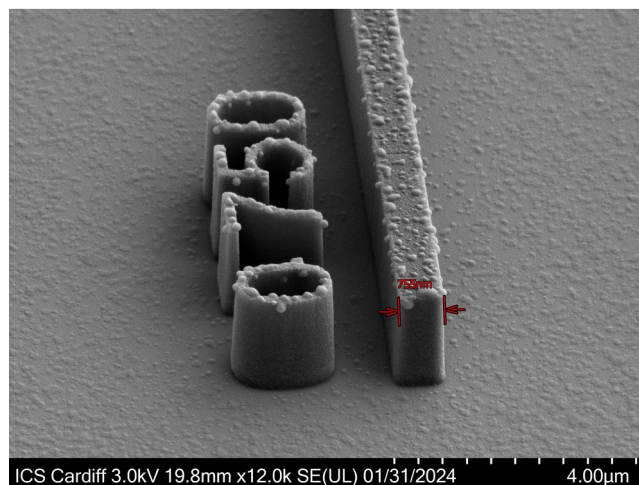


Figure 9 Representative structure with a measured 755 nm line.

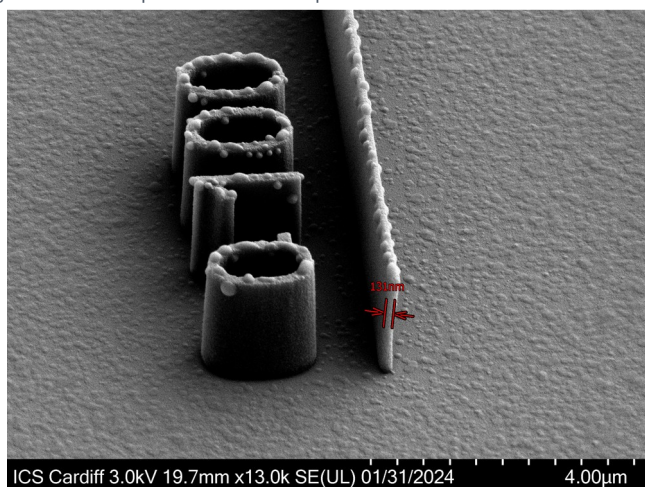


Figure 10 Representative structure with a measured 131 nm line.

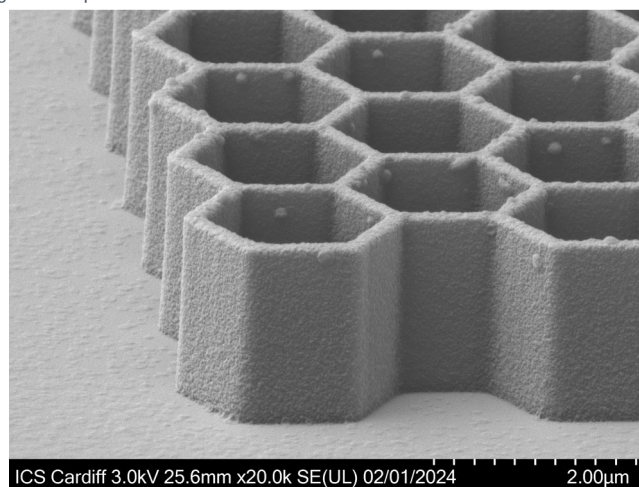


Figure 11 Hexagonal cell array.

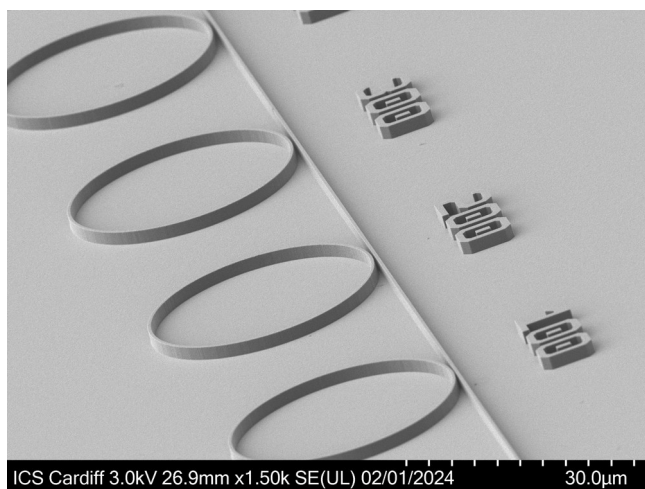


Figure 12 Ring and resonator pattern.

Acknowledgement

We are grateful to Dr Tomas Peach of the Institute for Compound Semiconductors at Cardiff University for providing the SEM images on this page and in Figure 1, and for granting permission to reproduce them.

Interpretation of the images

The annotated dimensions refer to gold-coated samples. The coating thickness was not specified, so no dimensional correction is applied. These examples are not guaranteed resolution or dose specifications.

Process results depend on substrate, film thickness, electron-beam tool, pattern density, proximity correction, bake and development conditions. Users must determine suitability in their own process and consult the current safety data sheet before use. Technical support tech@microchemicals.de