Selecting Centric vs. Aplanatic RSIL

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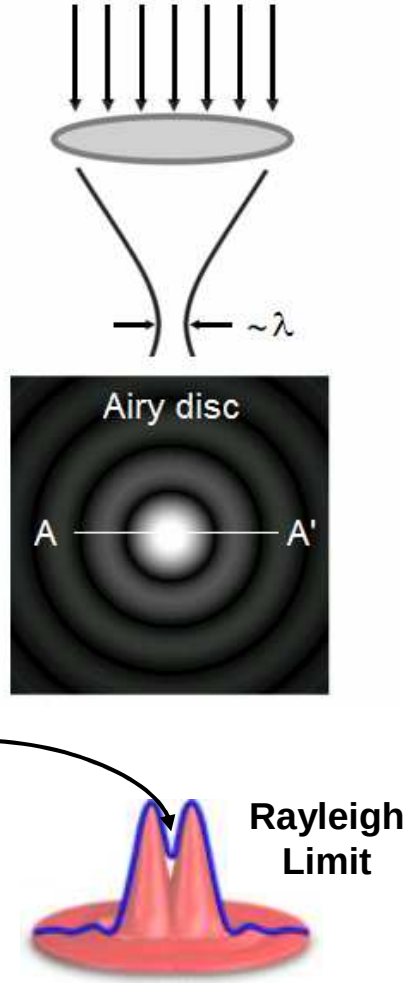
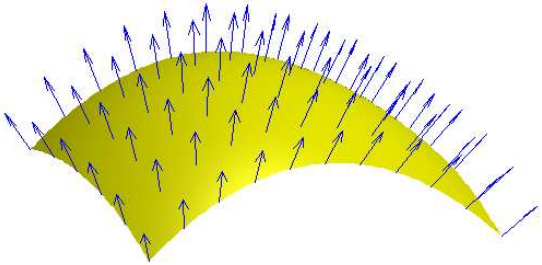
Diffraction Limited Resolution

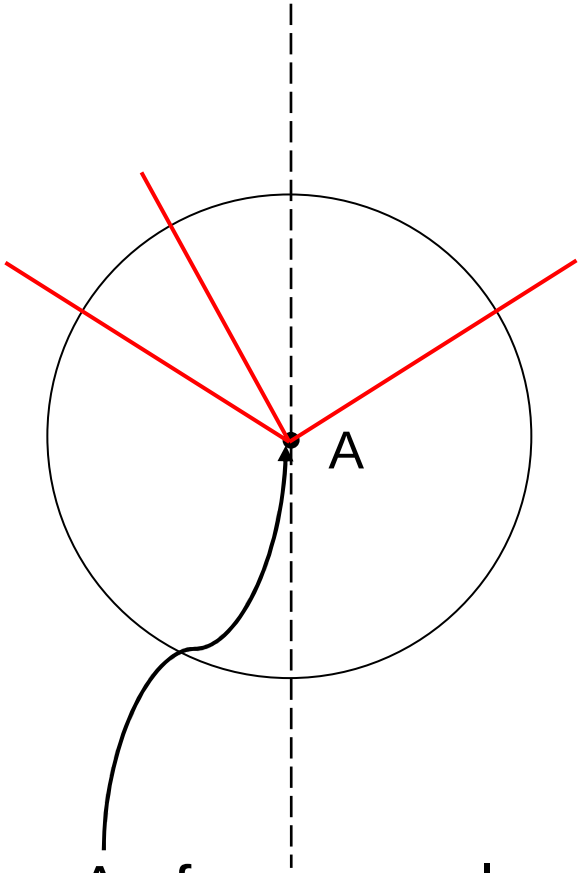
Laser wavelength: 1340nm
Objective NA: 0.6
Spatial resolution: ≈ 1.36µm



$(r) = 0.61\lambda / NA$
$NA = 0.6$

RSIL – Centric





Centric – Light from A of any wavelength exits RSIL normal to the surface with magnification of 3.5X

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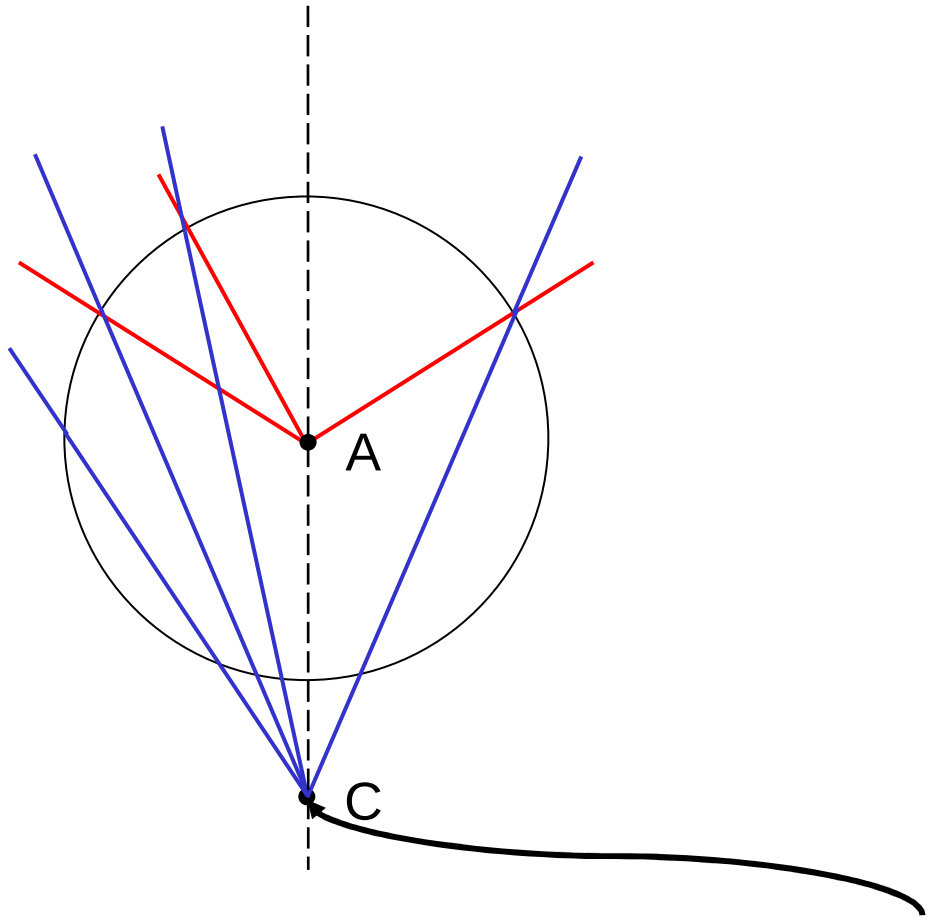
RSIL – Aplanatic



Aplanatic – Light appears to emit from point C

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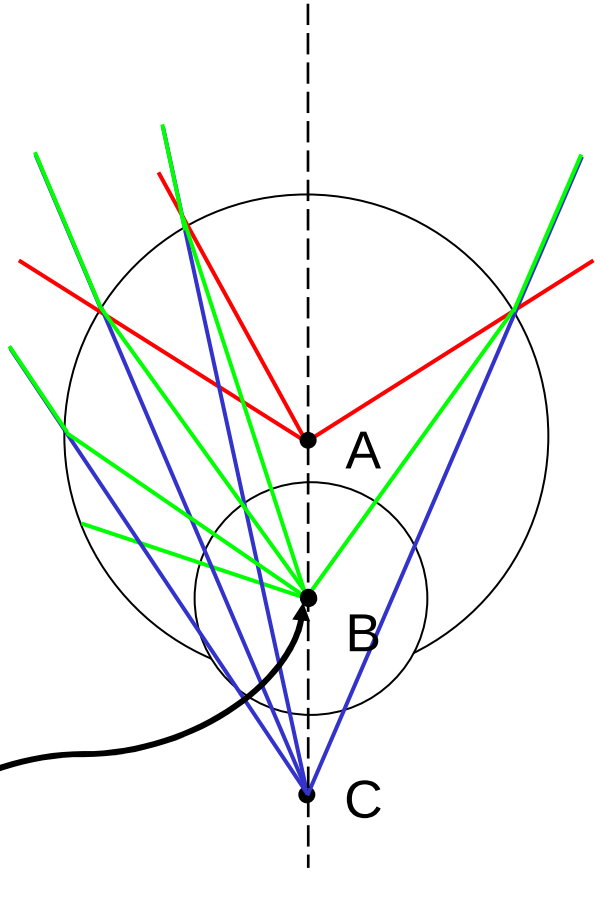
RSIL – Aplanatic Point



Aplanatic – B is the Aplanatic Point and is aberration-free

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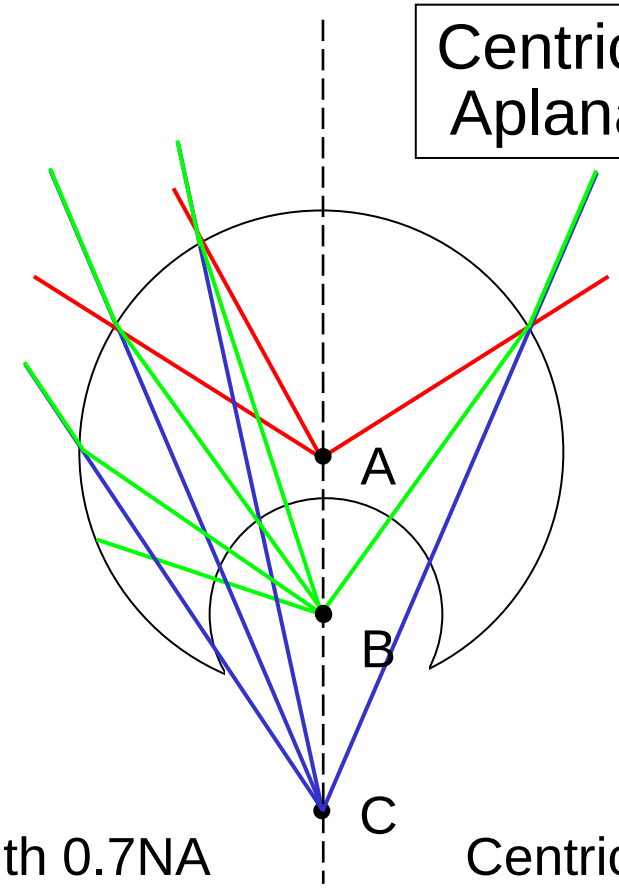
RSIL – Magnification

Centric mag = 3.5X
Aplanatic mag = 12.25X



Aplanatic: 100X lens with 0.7NA
- 12.25 X 100 = 1225X mag
- 12.25 X 0.7 = 3.5NA (max.)

Centric: 100X lens with 0.7NA
- 3.5 X100 = 350X mag
- 3.5 X 0.7 = 2.47NA

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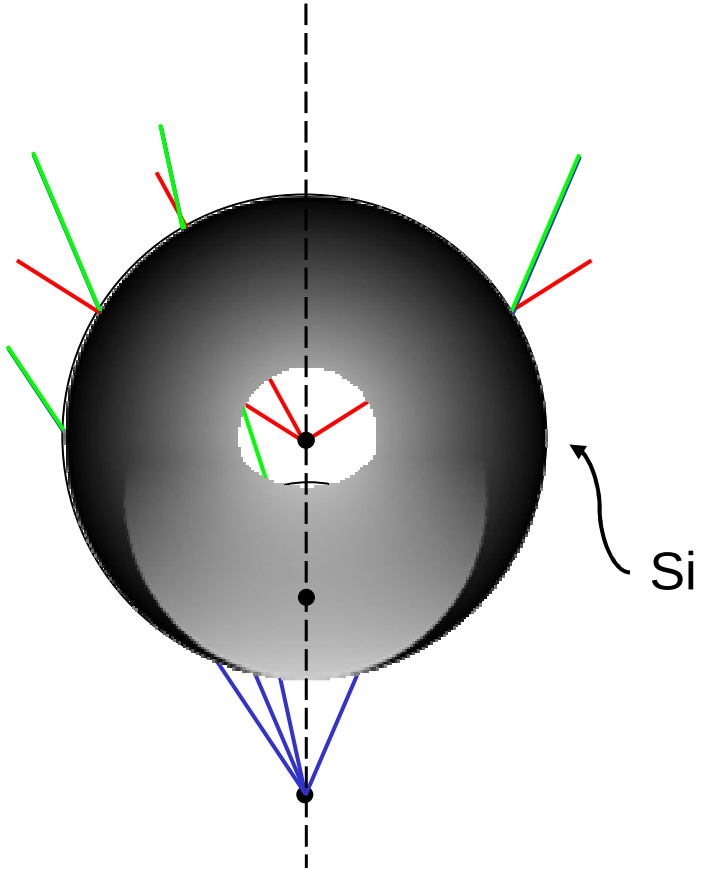
Shaping an RSIL



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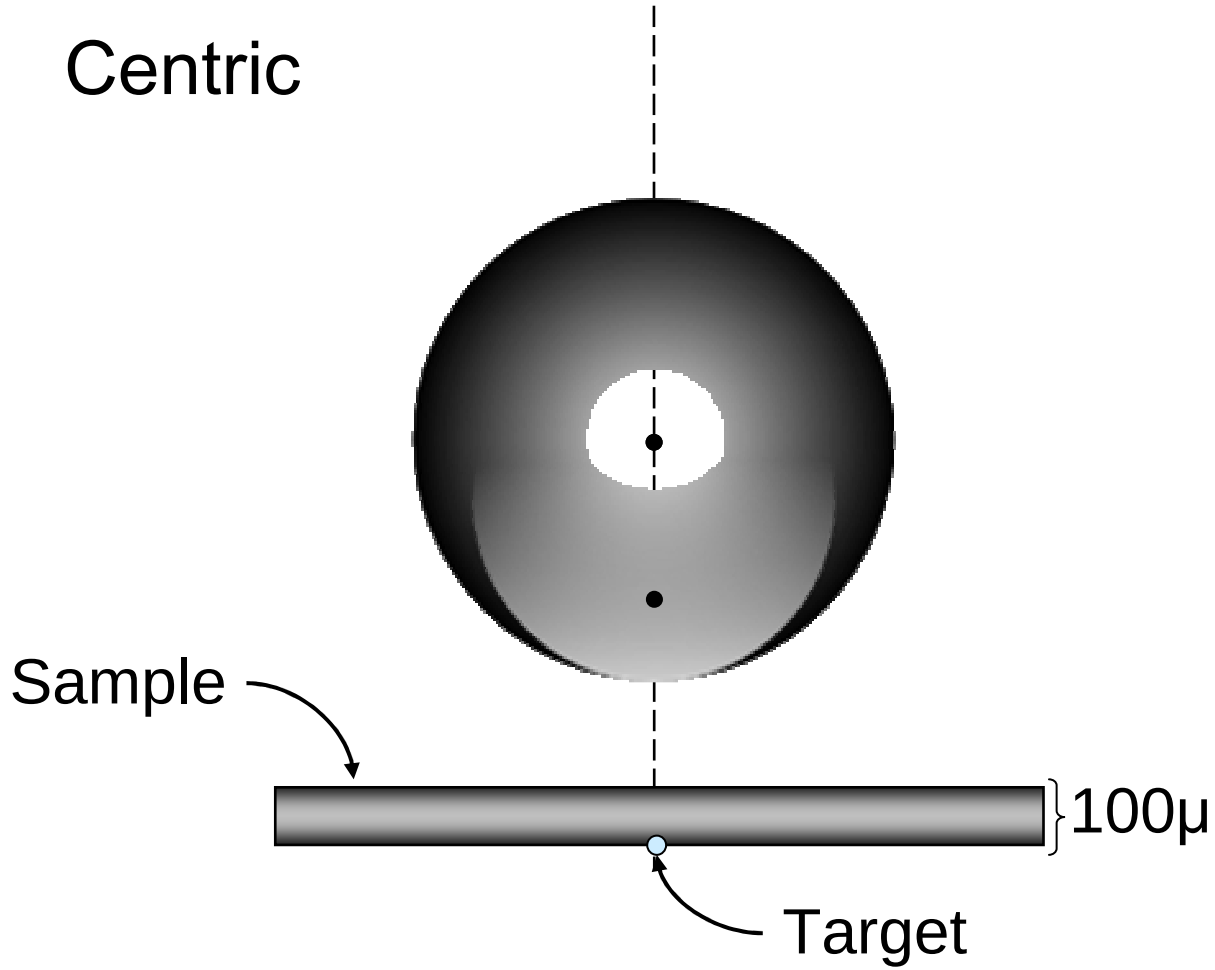
Shaping an RSIL



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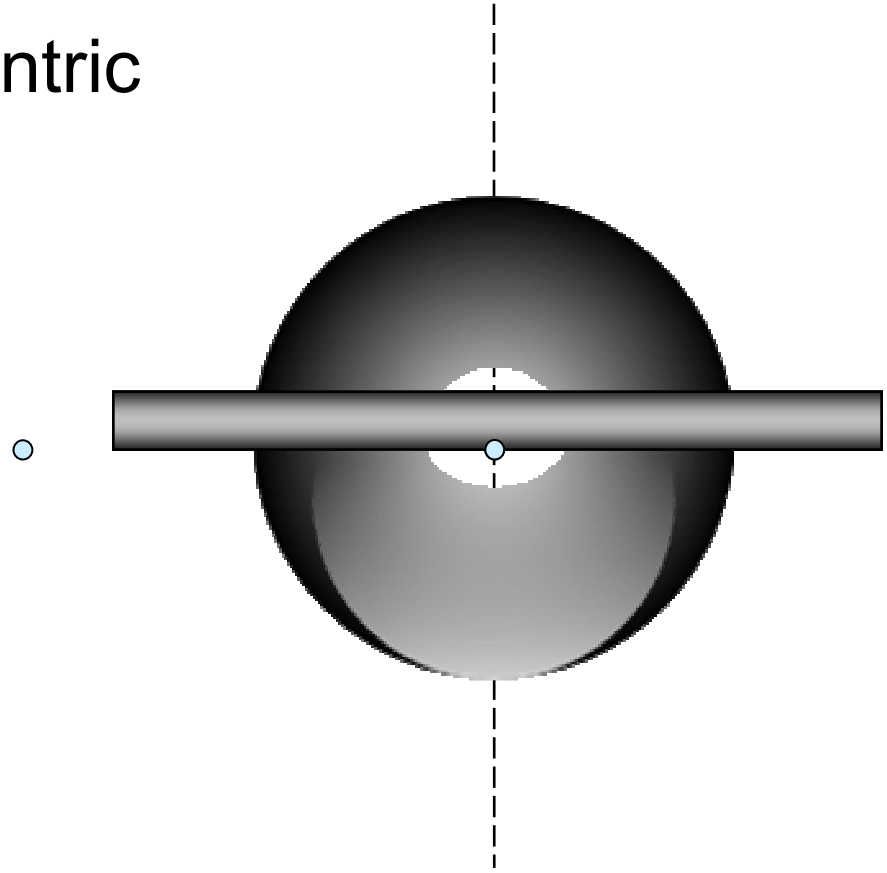
Shaping an RSIL



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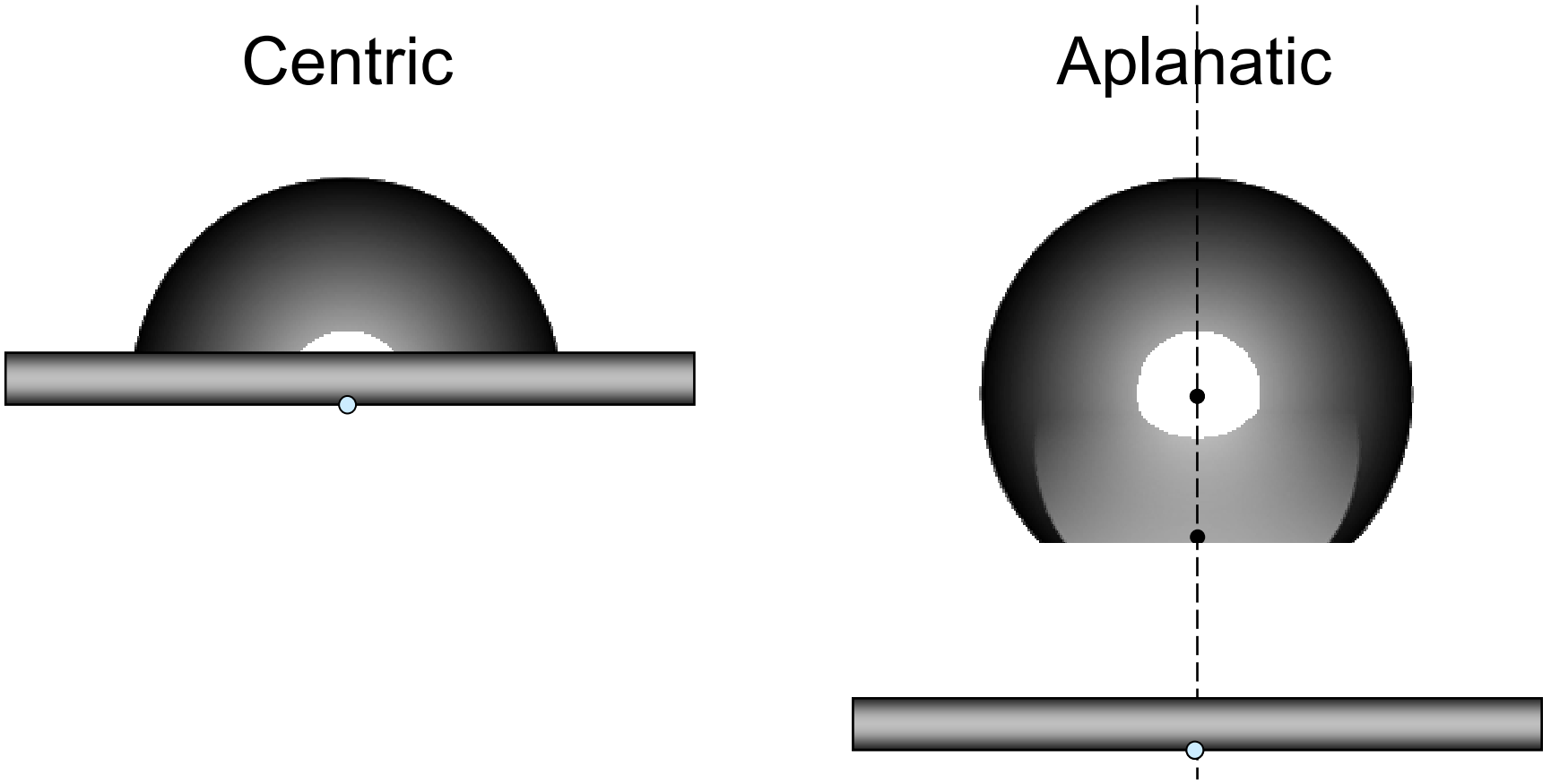

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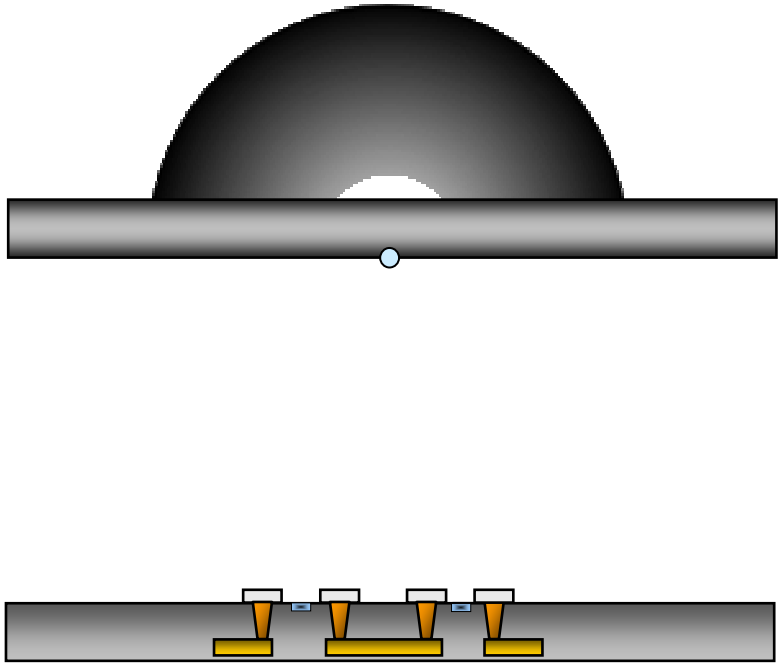
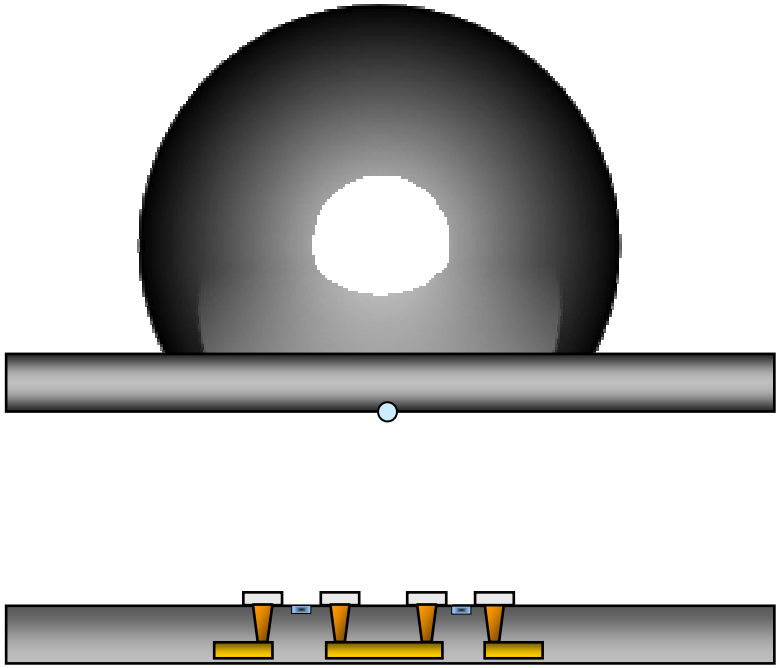
Shaping an RSIL

Centric



Aplanatic



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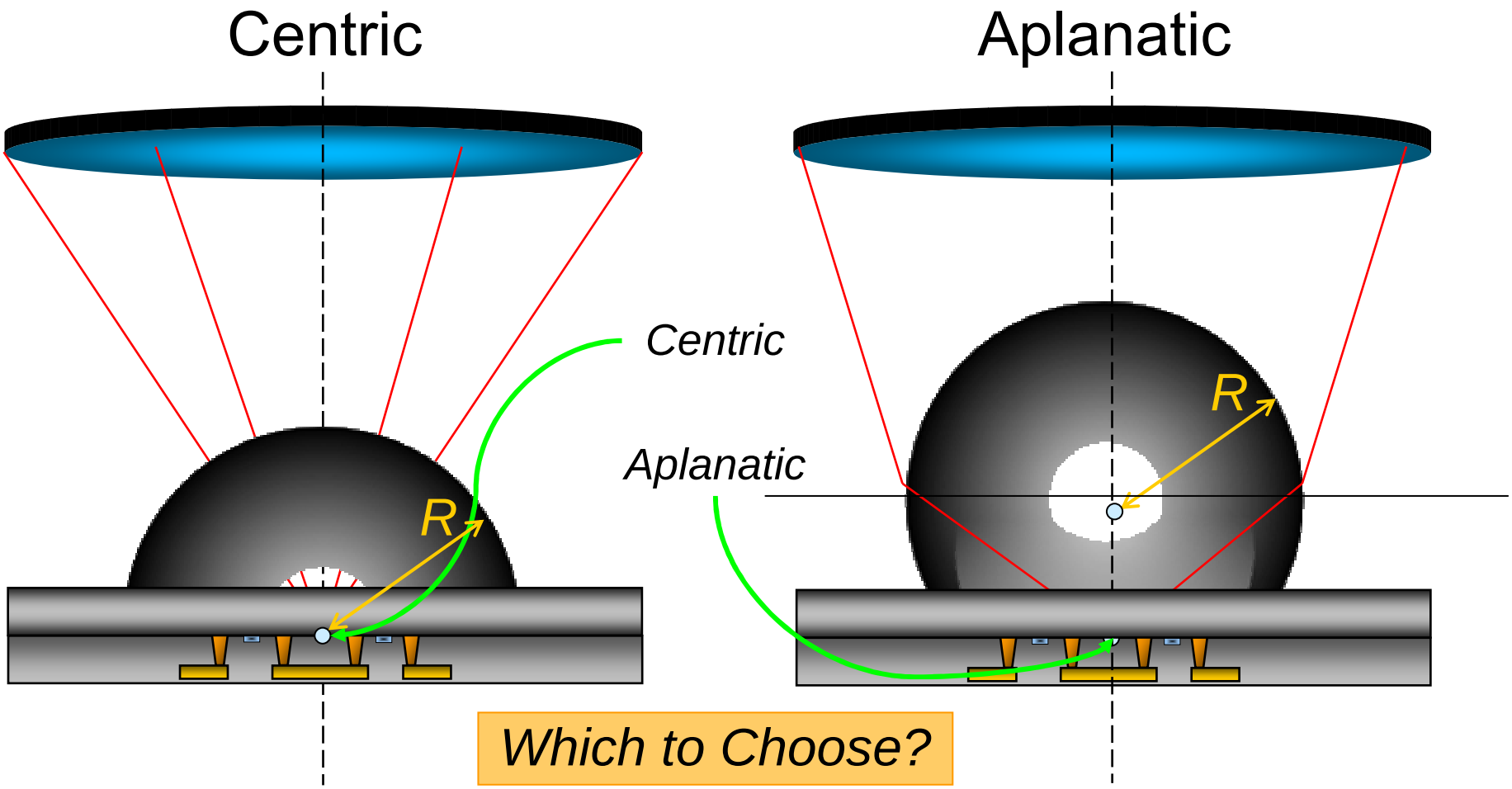
Selecting an RSIL



Which to Choose?

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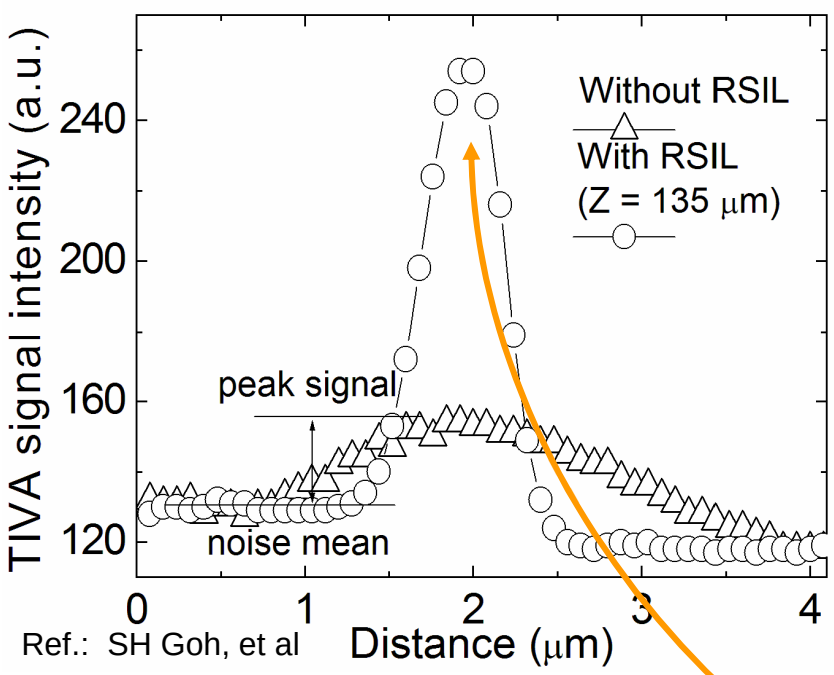
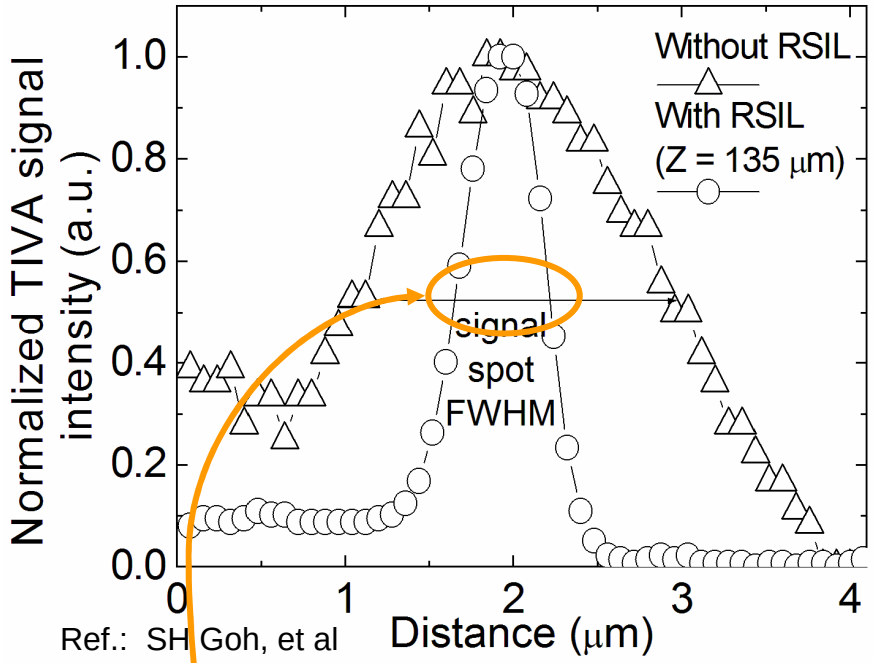
TIVA Spot Size – RSIL vs. Air-gap

Line profile



Normalized line profile



Selected:

1. RSIL

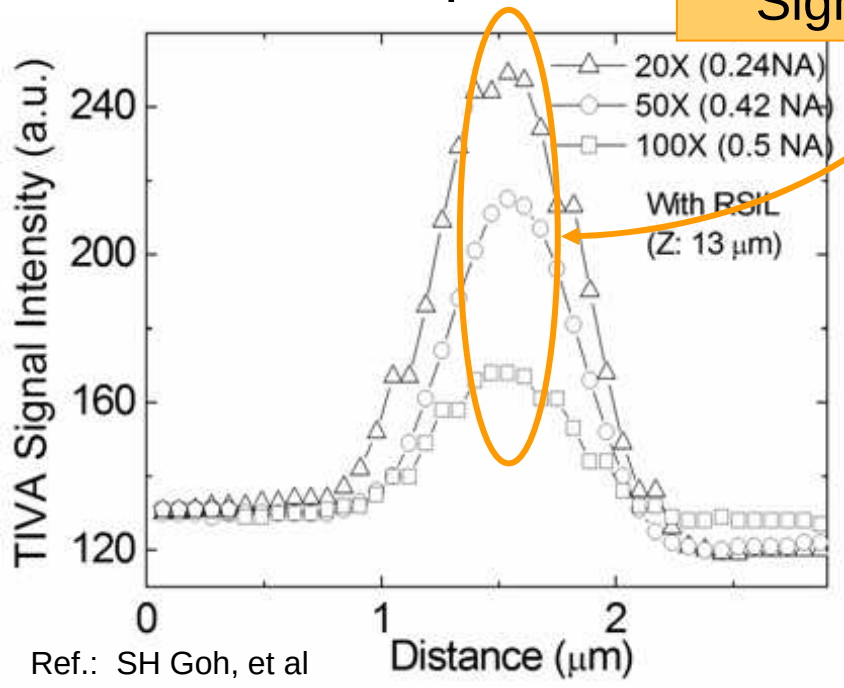
TIVA RSIL

- Higher Signal
- Smaller Spot Size

Signal Strength vs. Objective Size

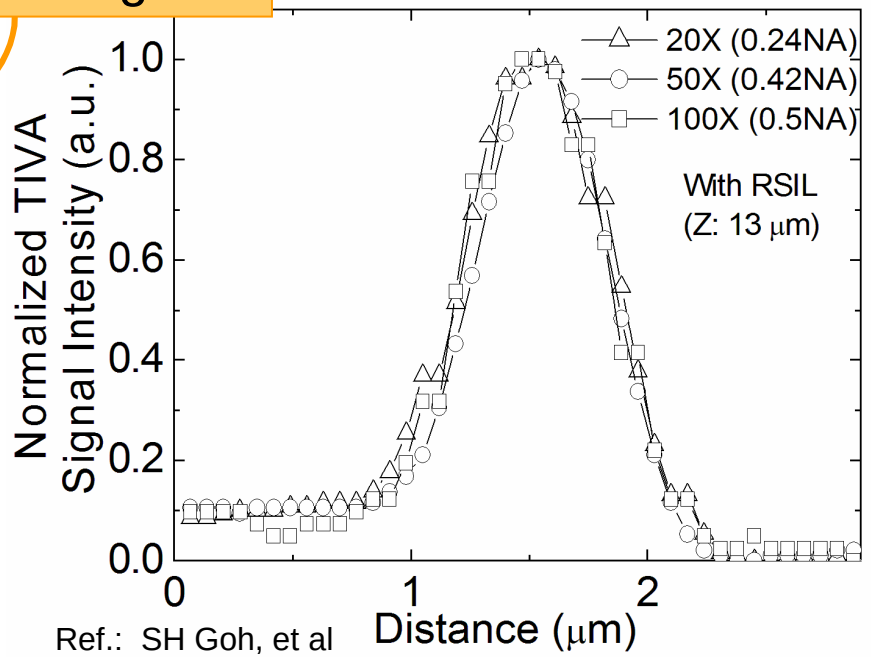
Line profile

Signal strength



Ref.: SH Goh, et al

Normalized line profile



Ref.: SH Goh, et al

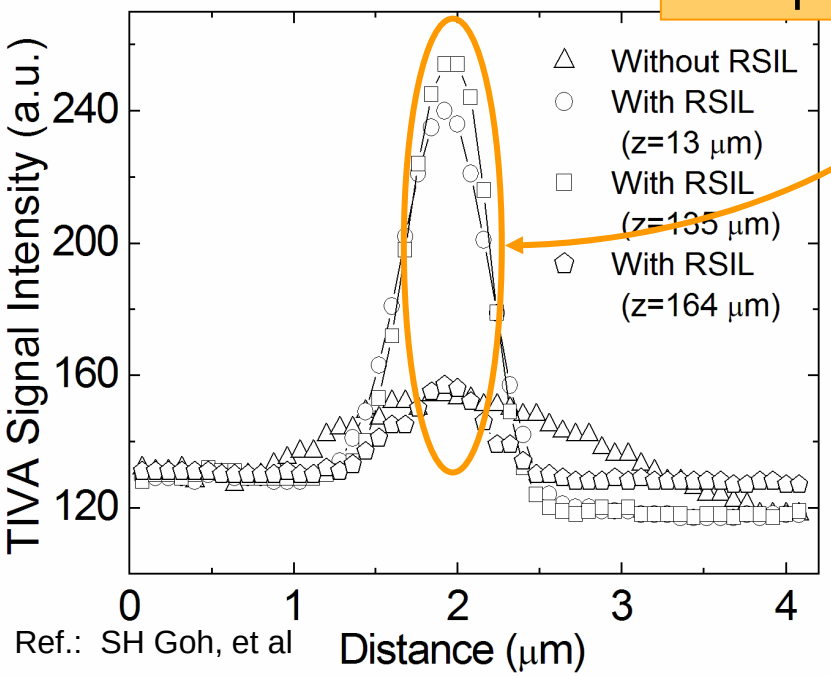
Selected:

1. RSIL
2. 20X objective

Signal Strength vs. Sample Thickness

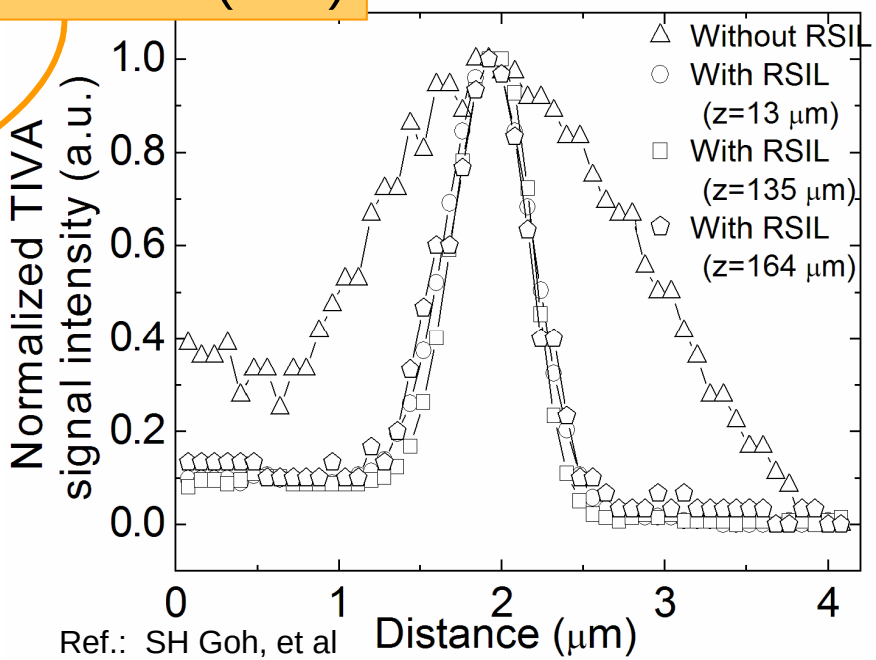
Line profile

Sample thickness (loss)



Ref.: SH Goh, et al

Normalized line profile

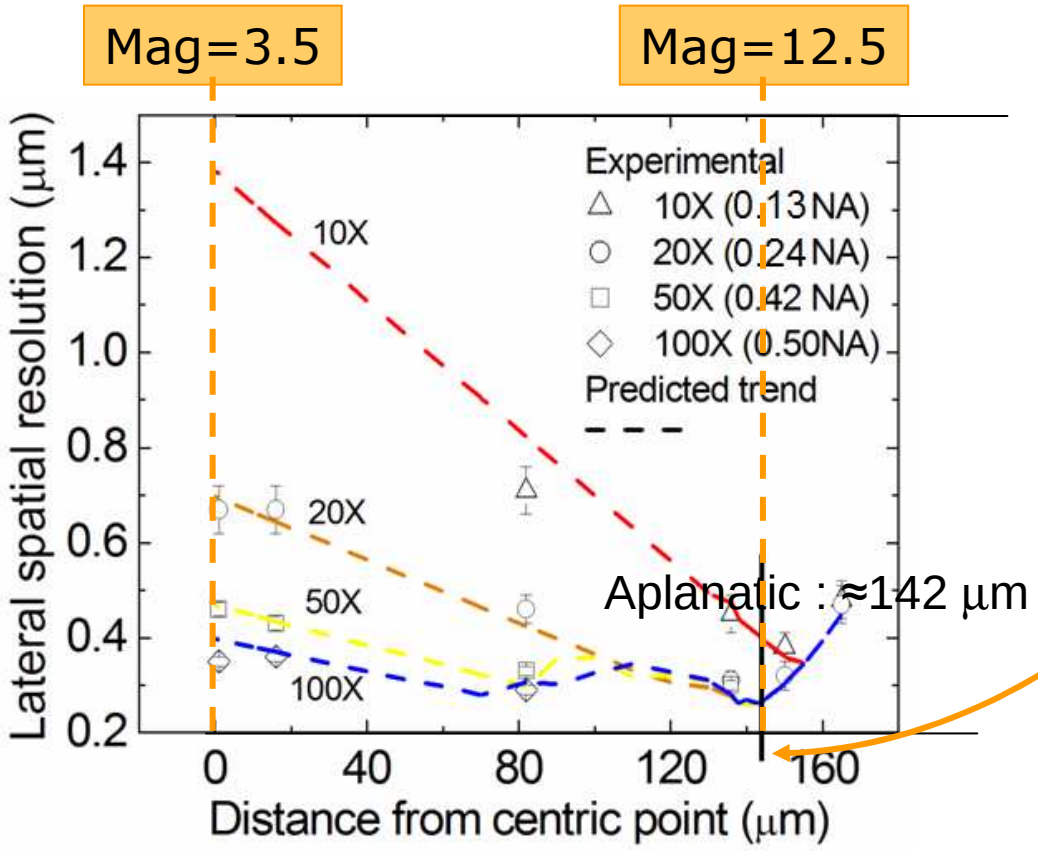


Ref.: SH Goh, et al

Selected:

1. RSIL
2. 20X objective
3. Correct part thickness

Resolution vs. Sample Thickness

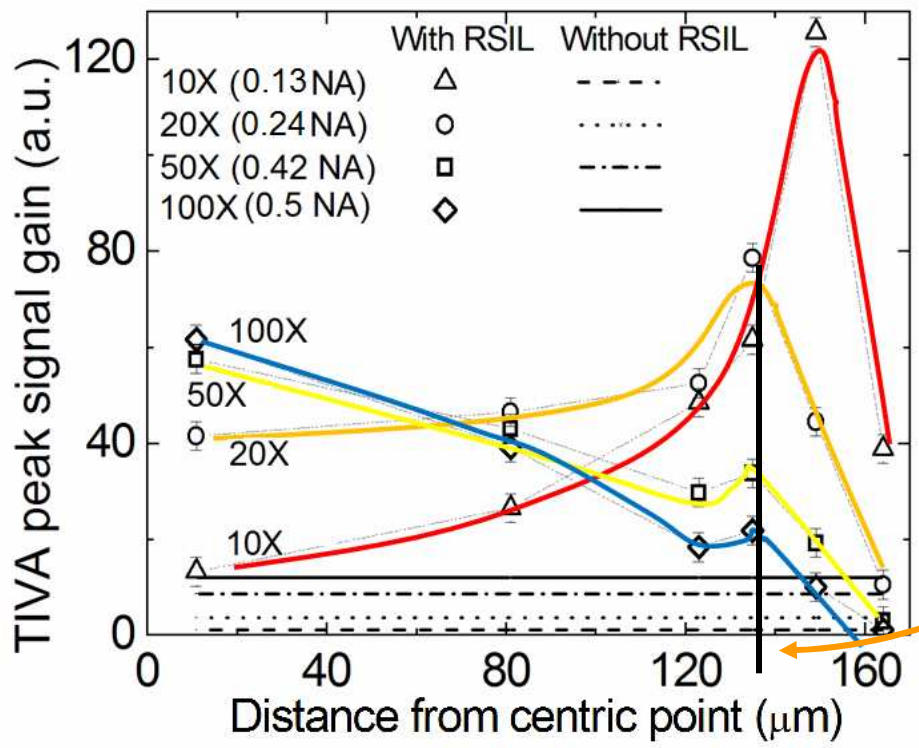


Ref.: SH Goh, et al

At Aplanatic Point
20X = 100X

Selected:
1. RSIL
2. 20X objective
3. Minimum part thickness
4. Aplanatic + 20X (cost)

Signal Strength vs. Sample Thickness



At Aplanatic Point
20X>>100X

Selected:

1. RSIL
2. 20X objective
3. Minimum part thickness
4. Aplanatic 20X
5. Aplanatic 20X

Centric vs. Aplanatic RSIL

Centric RSIL

- Aberration-free
- No refraction at lens curvature
- Resolution improved by 3.5X
- Magnification increase 3.5X
- No chromatic aberrations

Aplanatic RSIL

- Aberration-free
- Refraction at lens curvature
- Resolution improves by > 3.5X
- Magnification increase up to 12X
- Single λ only

Good for PEM Applications

Good for TIVA and LTP

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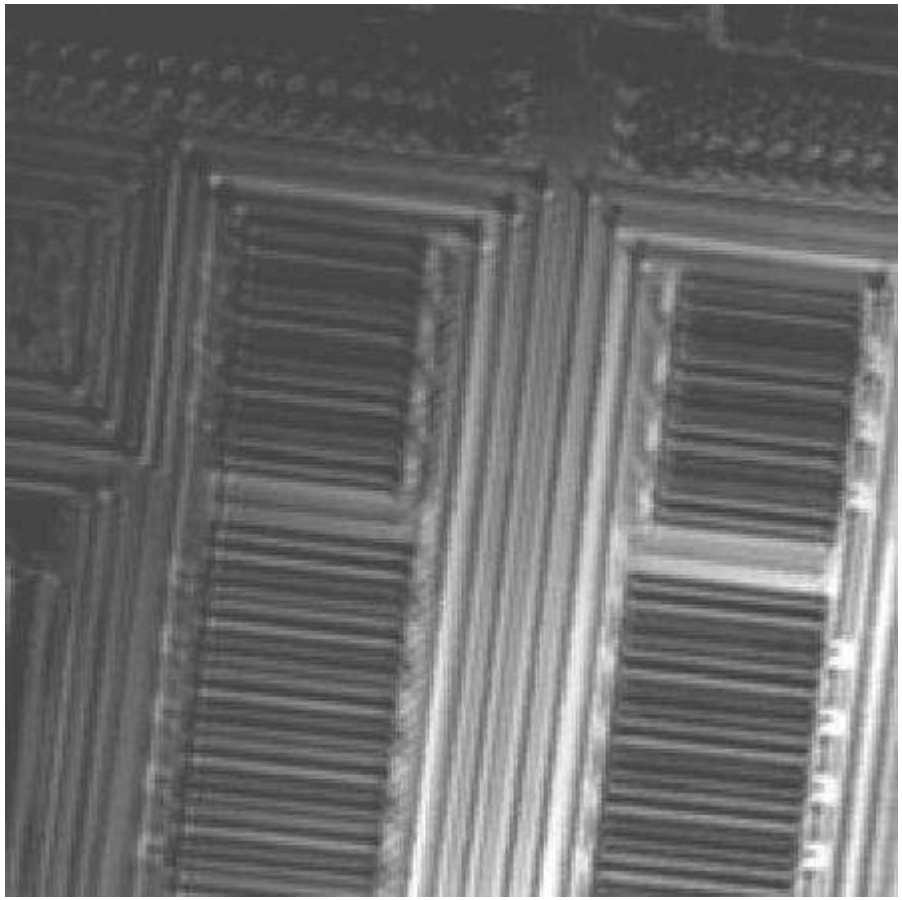
Centric vs. Aplanatic

Centric RSIL



Aplanatic RSIL

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IPFA 2008

Effect of Refractive Solid Immersion Lens Parameters on the Enhancements of Laser Induced Fault Localization Techniques

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