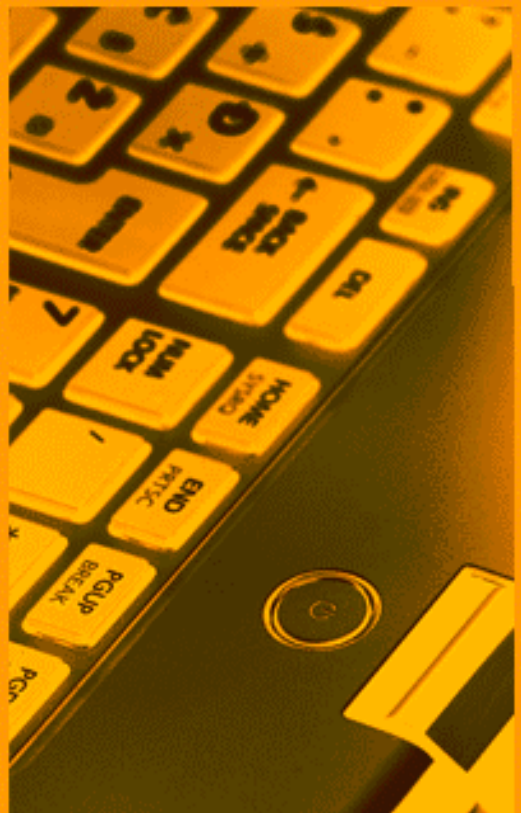
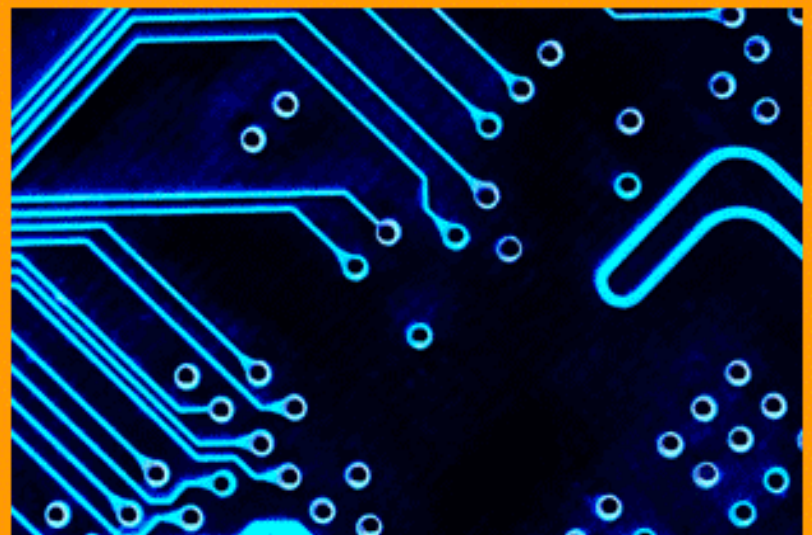
SGIA Printed Electronics Roundtable











Stencil Making for Fine Line Printed Electronics



Current state-of-the-art techniques

Topics for roundtable discussion:

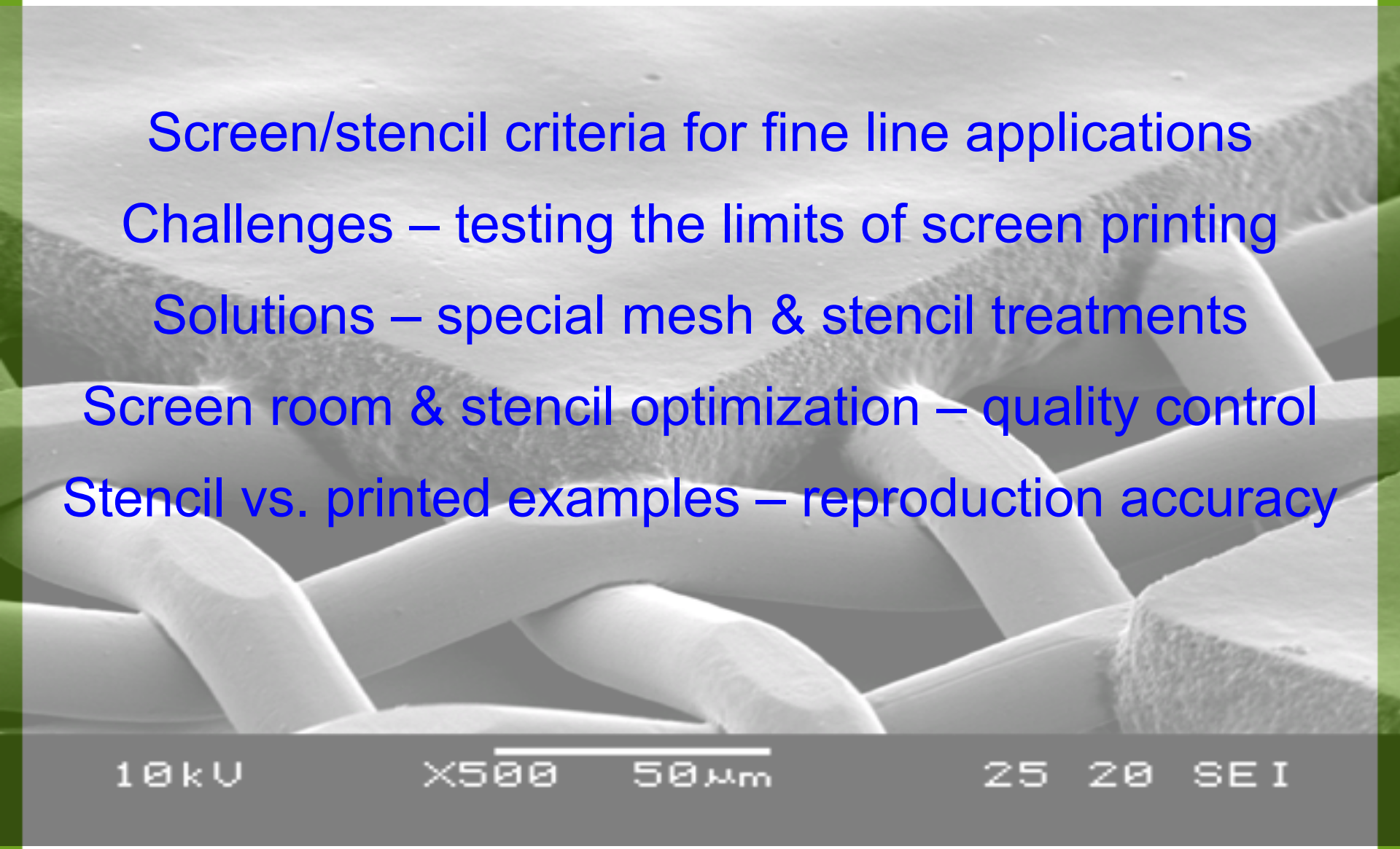
Screen/stencil criteria for fine line applications

Challenges – testing the limits of screen printing

Solutions – special mesh & stencil treatments

Screen room & stencil optimization – quality control

Stencil vs. printed examples – reproduction accuracy



Criteria for Fine Line Printed Electronics

- Work in clean room environment
- Resolution of film template of 20,000 dpi +
- Optimize film template to mesh relationship
- Use thin thread/wire diameter mesh with high A_o
- For high aspect ratio fine line printing use meshes with 60% open area
- Use highest quality emulsion and/or film
- Optimize stencil profile

Precision Screen Printing Applications

Capacitive Touch Panel

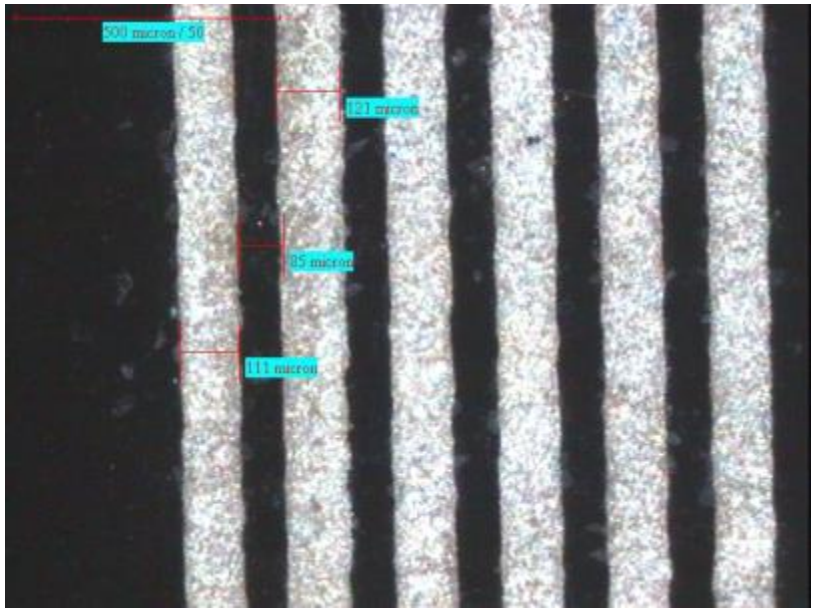


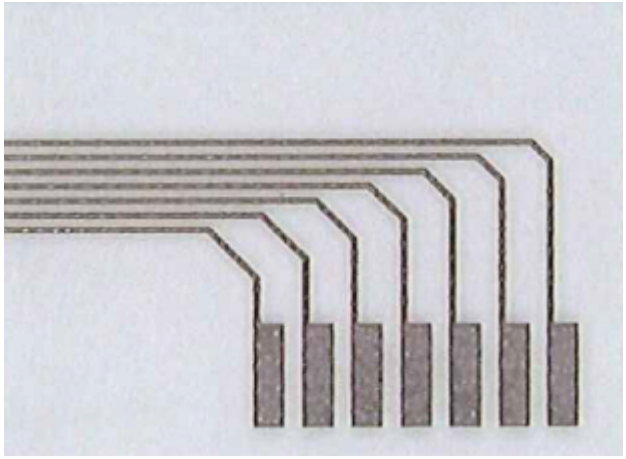


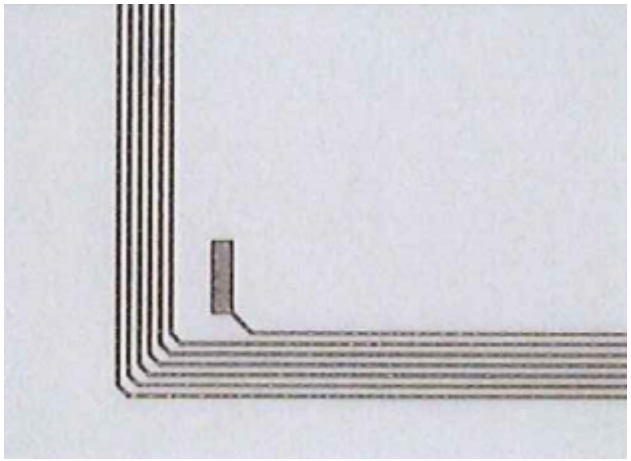
Cell Phone Lens

Line Width: 115µm

Line Spacing: 85µm







Film (Cell Phone)

50µm Touch Plane Screen Printing

SS Wire Mesh: 500-19 CL 25

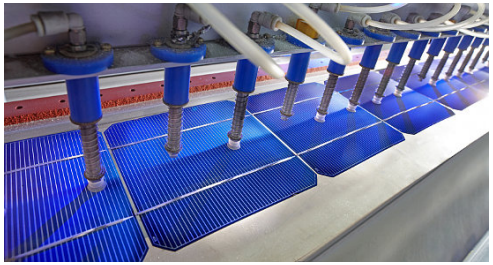
EOM: 12 µm

Film Width: 53 µm

Stencil Width: 51±1µm (50-52 µm)



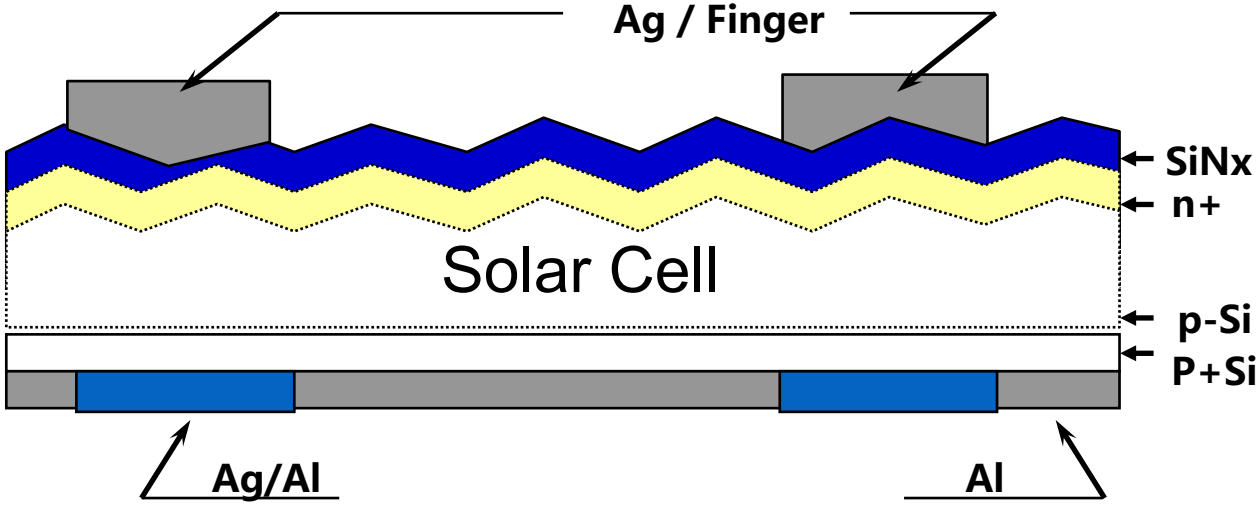
Solar Cell



http://www.pv-tech.org/assets/images/suntech



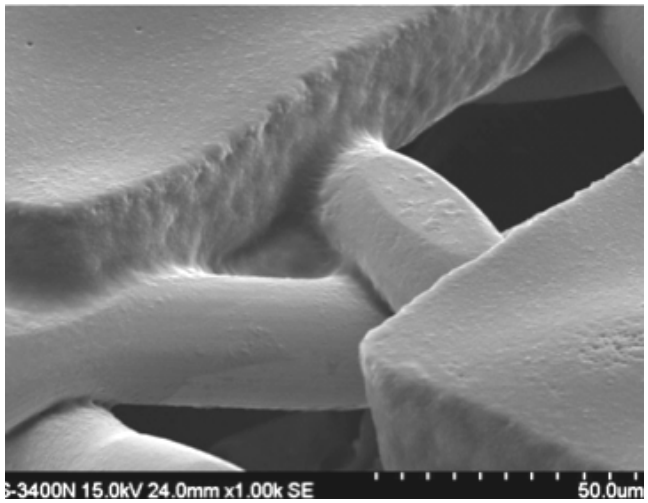
http://www.sunpowercorp.co.uk



Screen Printed Components:

Front Side Finger Electrode	Ag Paste
Back Side Aluminum Surface Field (BSF)	Al Paste
Back Side Electrode (Back Bus BB)	Ag/Al Paste

Solar Cell



45 µm Solar Screen Printing

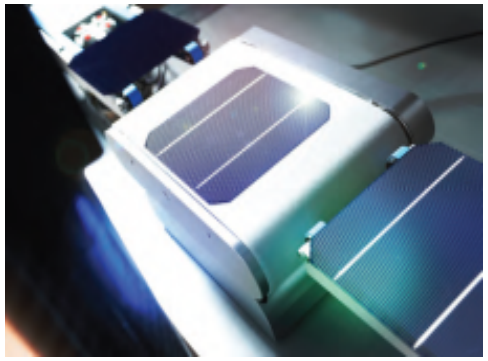
SS Wire Mesh: 290-20 CL 31

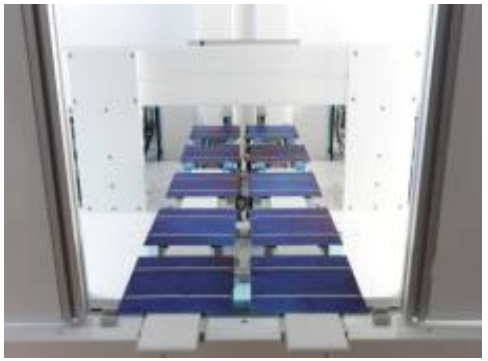
EOM: 20 µm

Film Width: 45 µm

Stencil Width: 43±1 µm (42-44 µm)







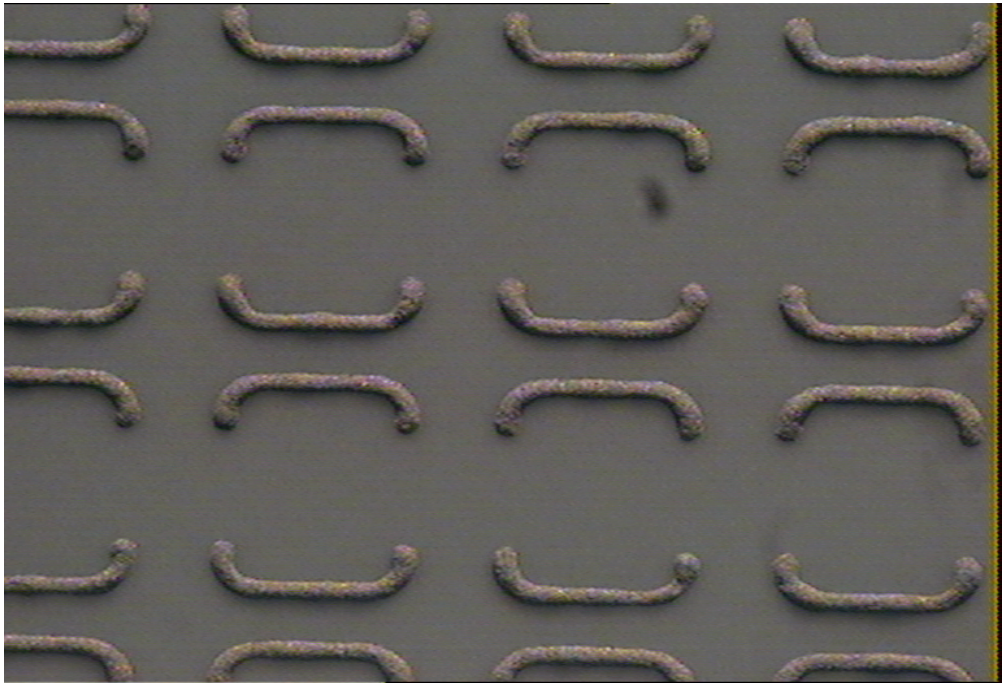
Component:
Low Temperature Co-fired Ceramic (LTCC) Multi-Layer Ceramic Capacitor (MLCC)

Wire Mesh: MS 400-23 CL 35

EOM: 15 µm

Substrate: 0.5 mm

40 µm Precision Screen Printing



Line Width: 42 µm (41-43 µm) Line Thickness: 11 µm

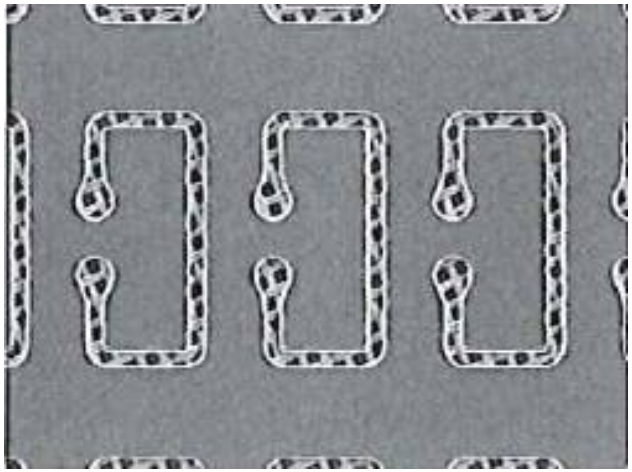
Component: LTCC / MLCC

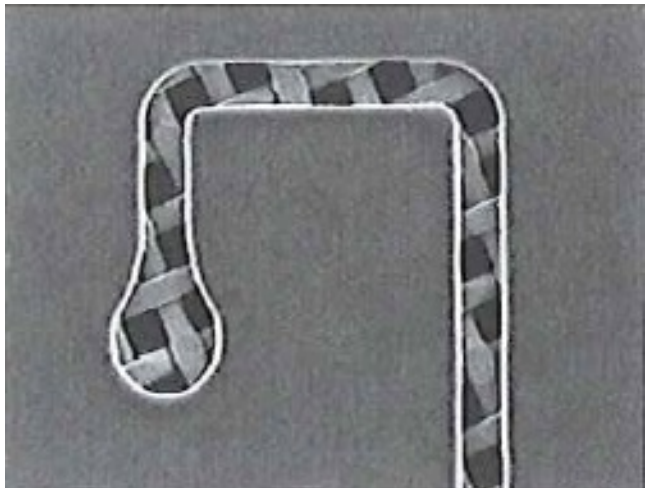
30 µm Precision Screen Printing

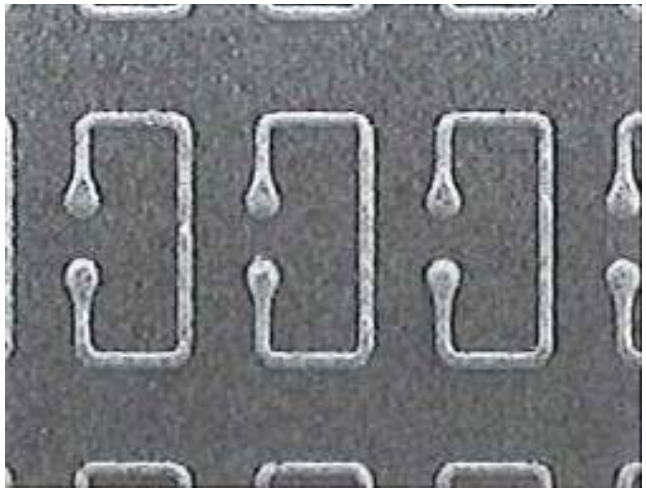
Wire Mesh: 640-15 Black CL 21

EOM: 17 µm

Ceramic Substrate: 0.2 mm







Screen Room Optimization



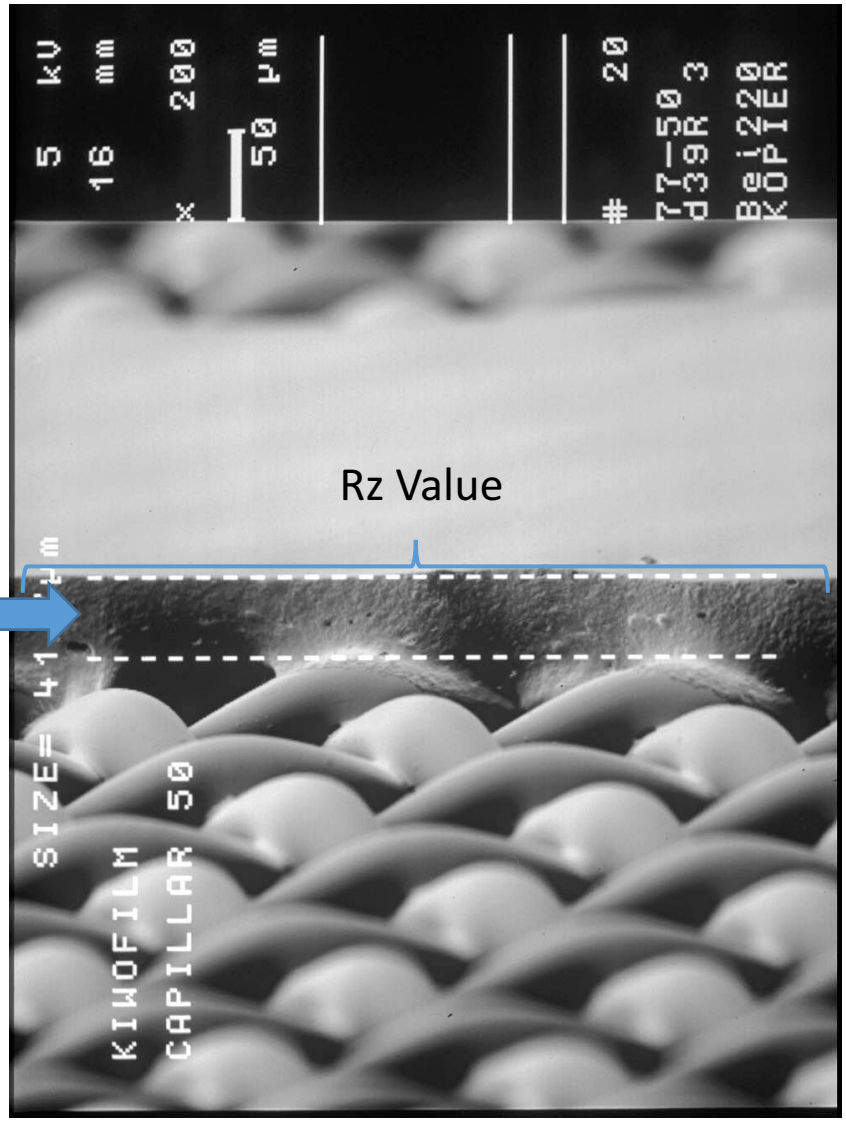
Emulsion/Film Coating







Stencil Specification

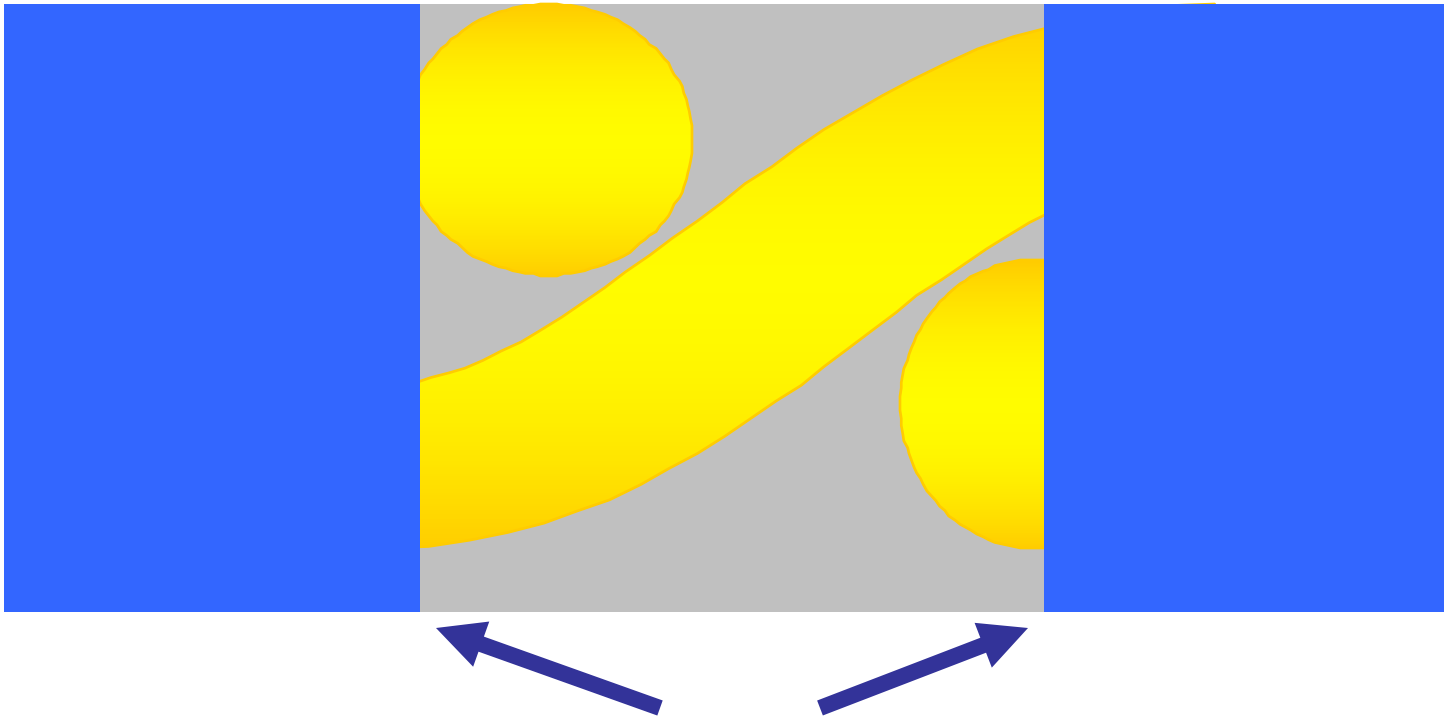


Stencil Thickness (EOM)

Good gasket

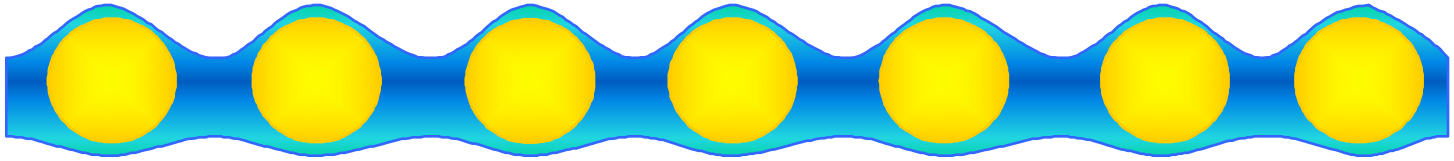
Reduces mesh interference

Improves line sharpness & accuracy

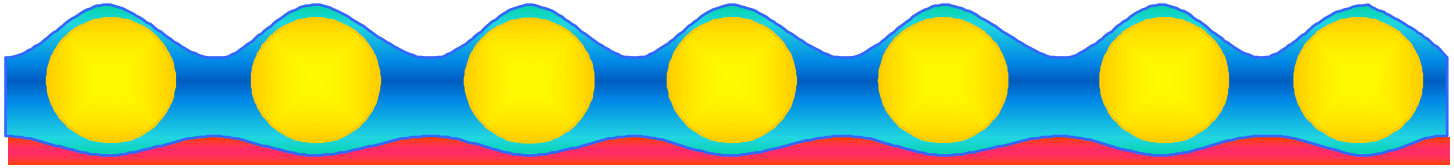


Defines edge, provides relief = accurate ink/paste transfer

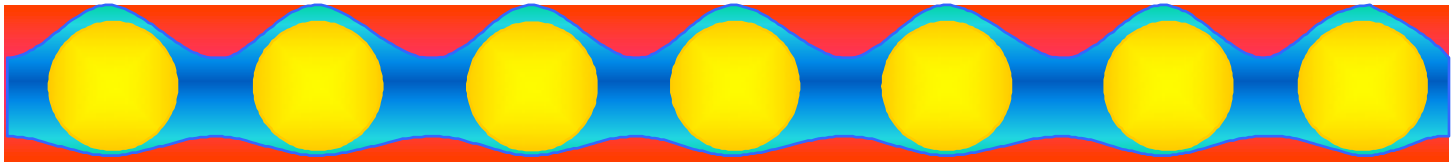
Stencil Smoothness (Rz value)



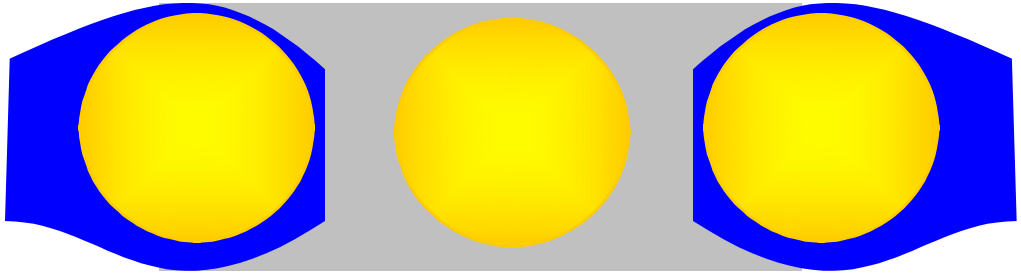
BASE Coating



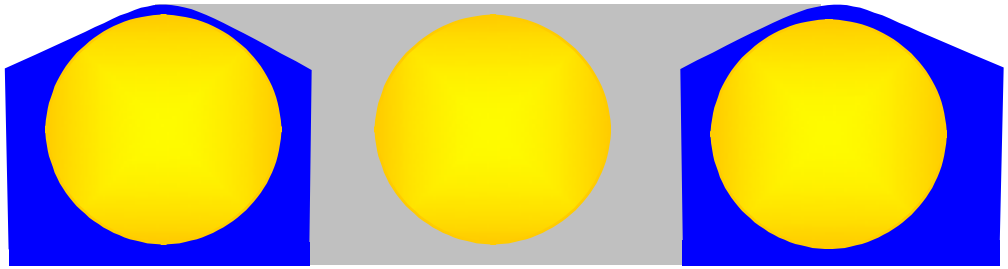
FACE Coating – Substrate Side



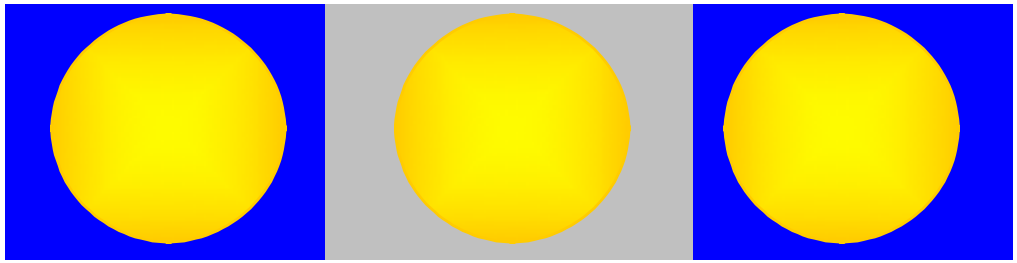
FACE Coating – Substrate & Squeegee Side



BASE Coating

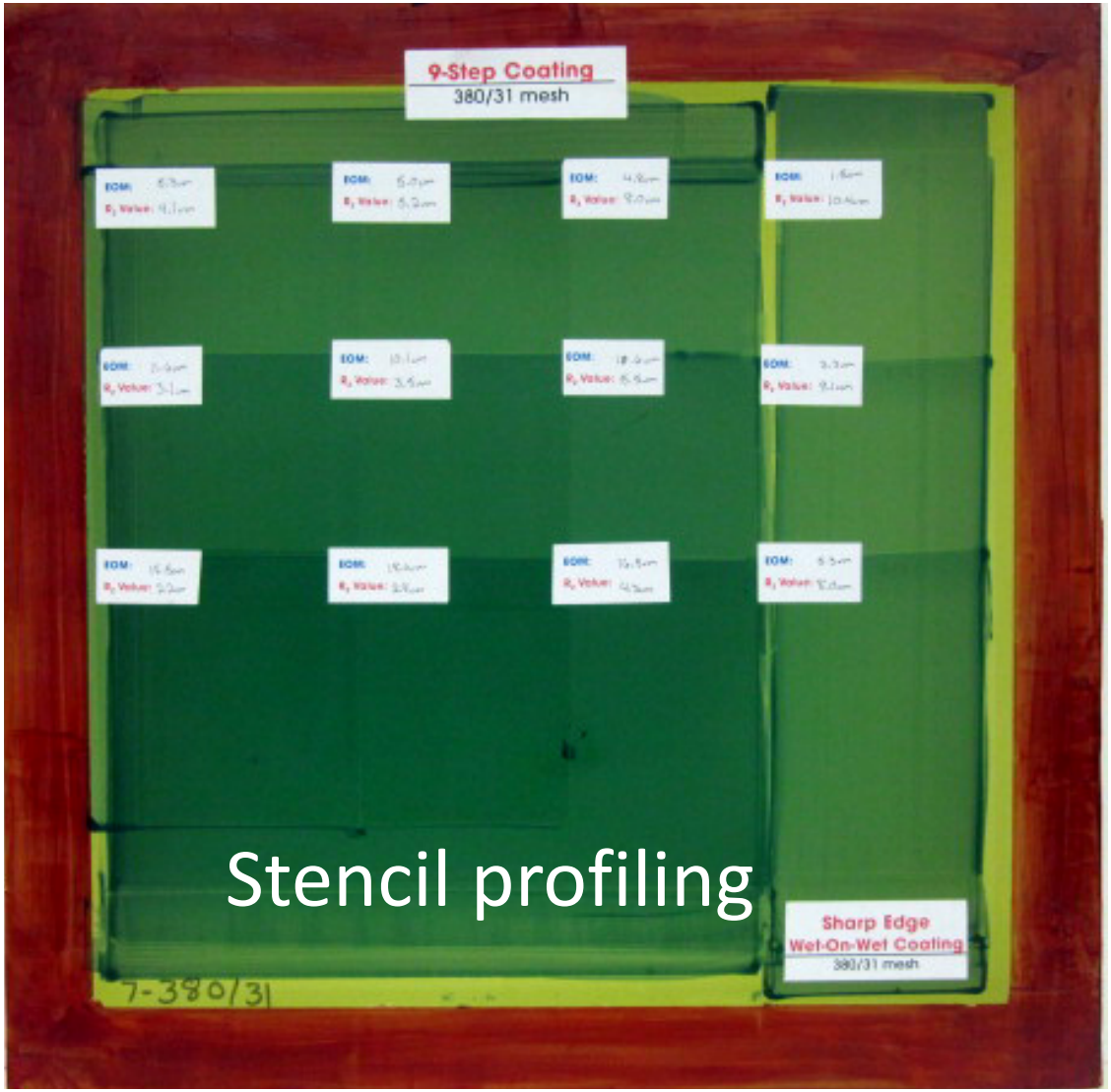


FACE Coating – Substrate Side

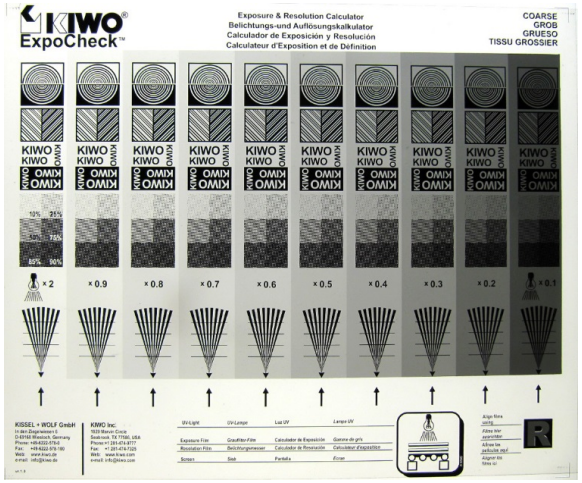


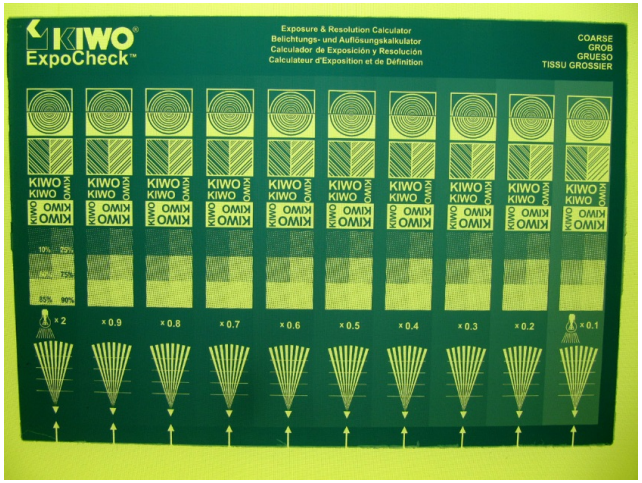
FACE Coating – Substrate & Squeegee Side

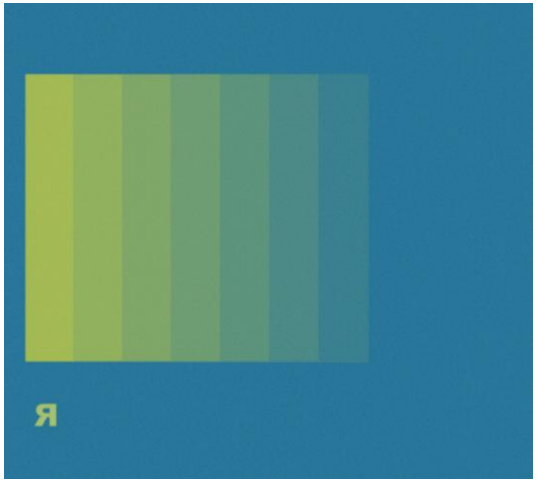
Coating Calibration



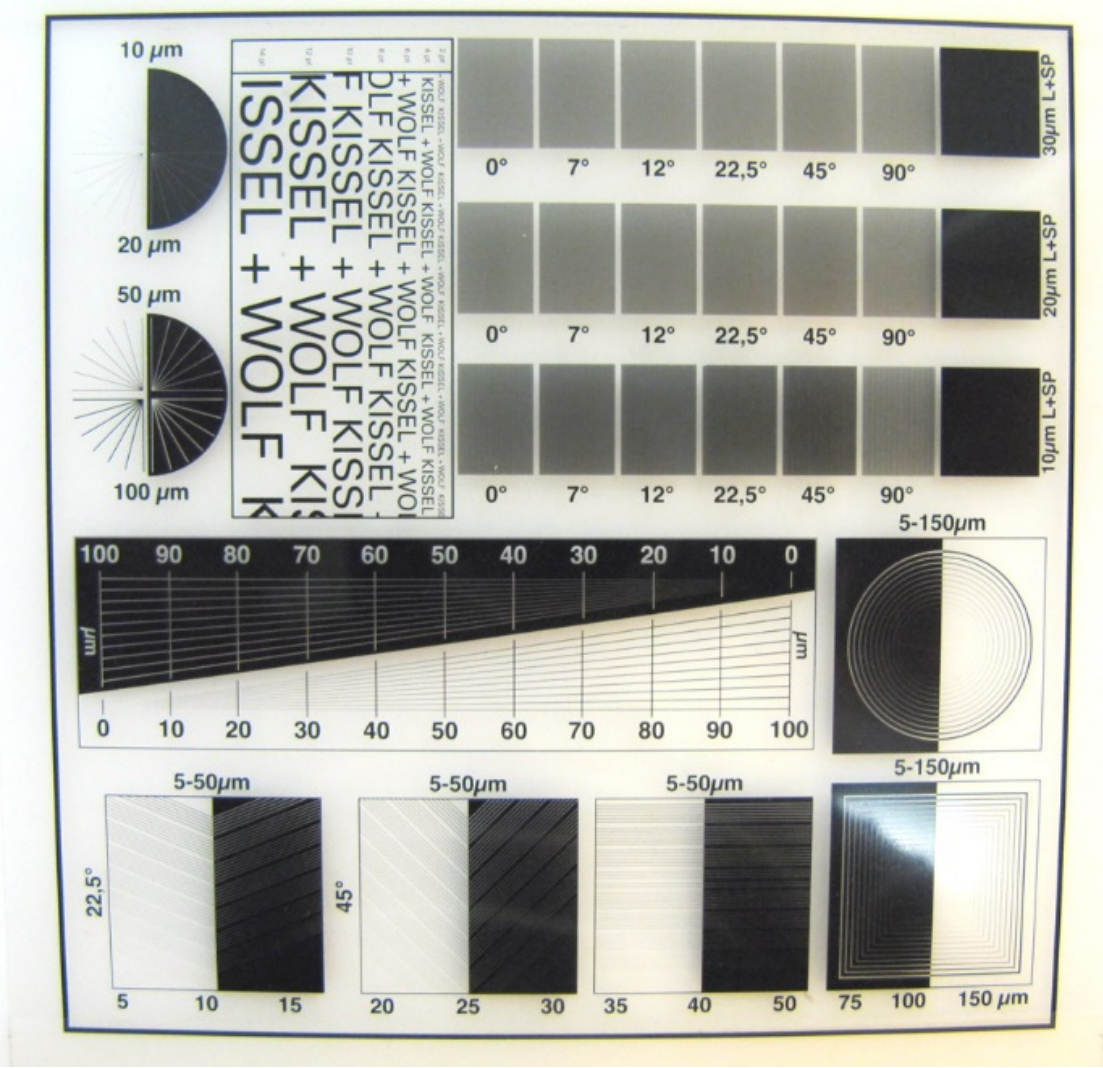
Exposure Calibration to Optimize Resistance & Resolution



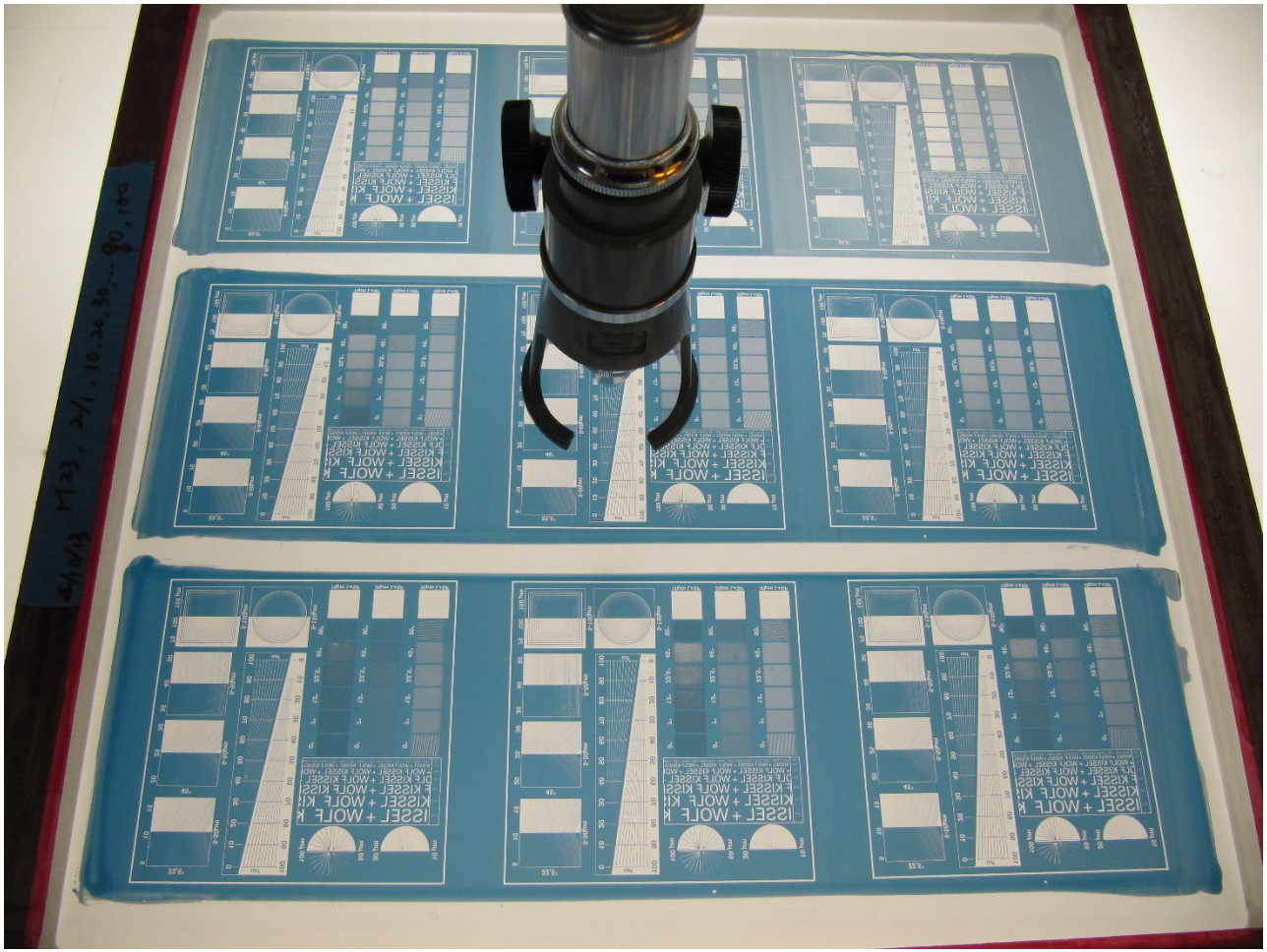




High Quality 20,000 dpi Test Film

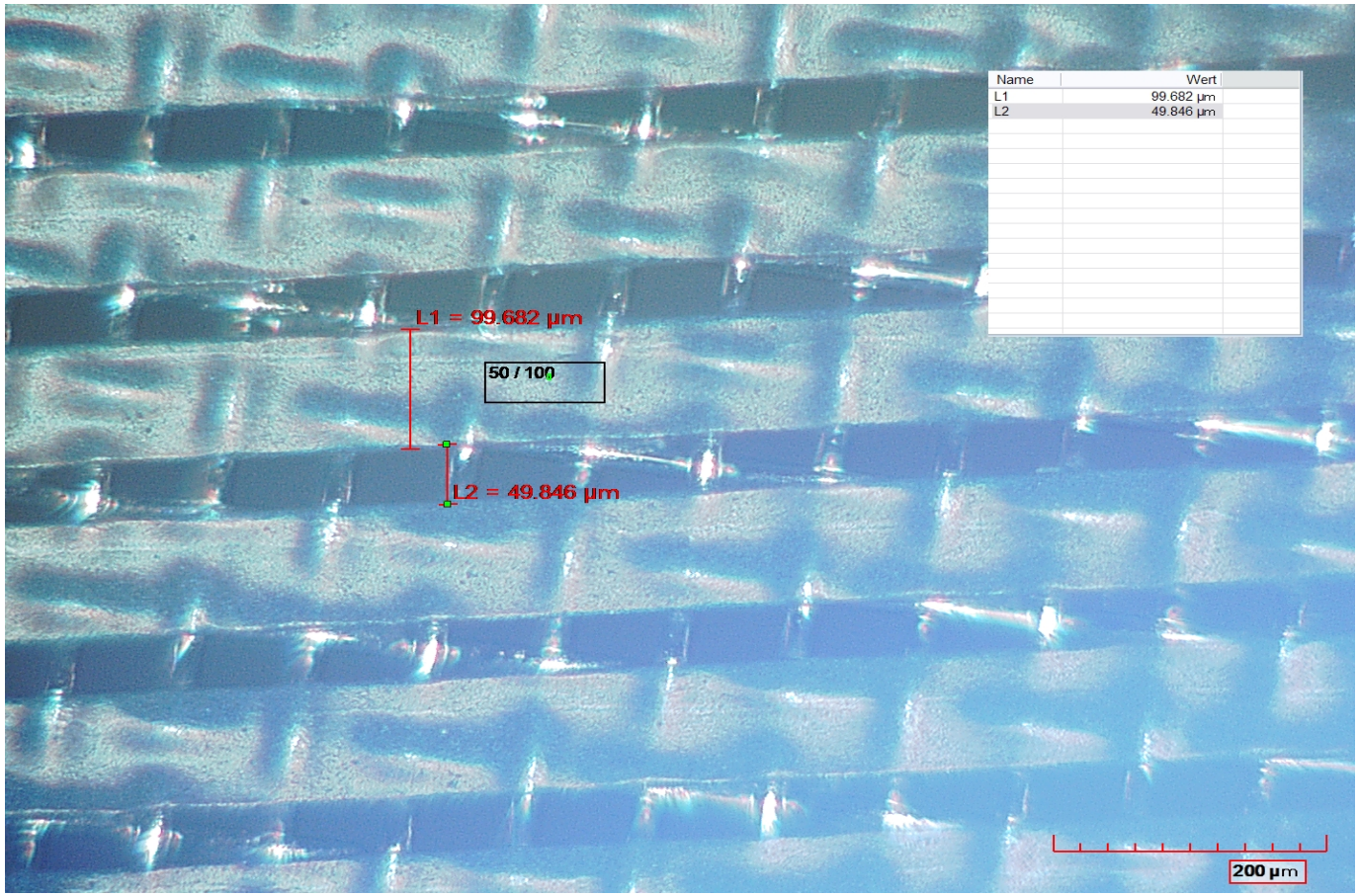


Stencil and Print Analysis

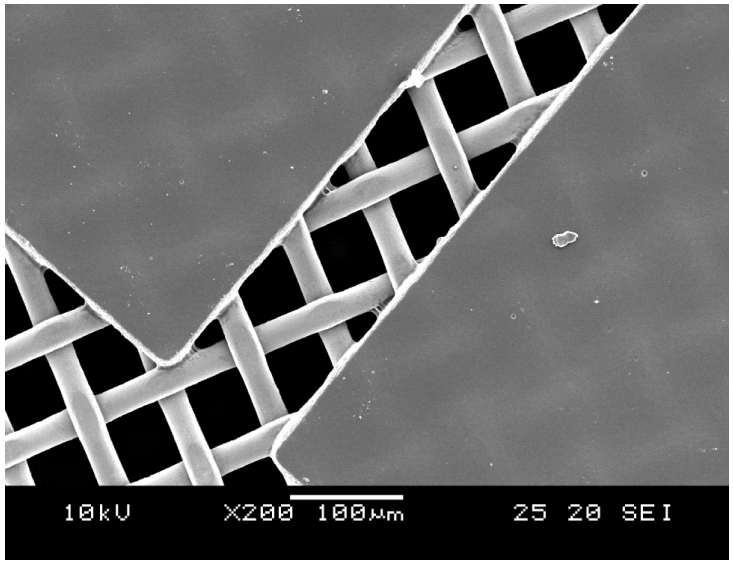


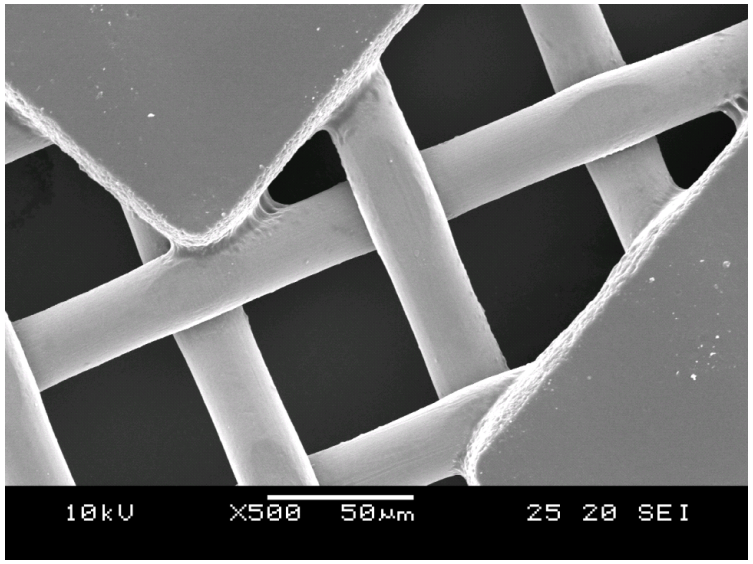
Reproduction accuracy of 50 µm line / 100 µm space

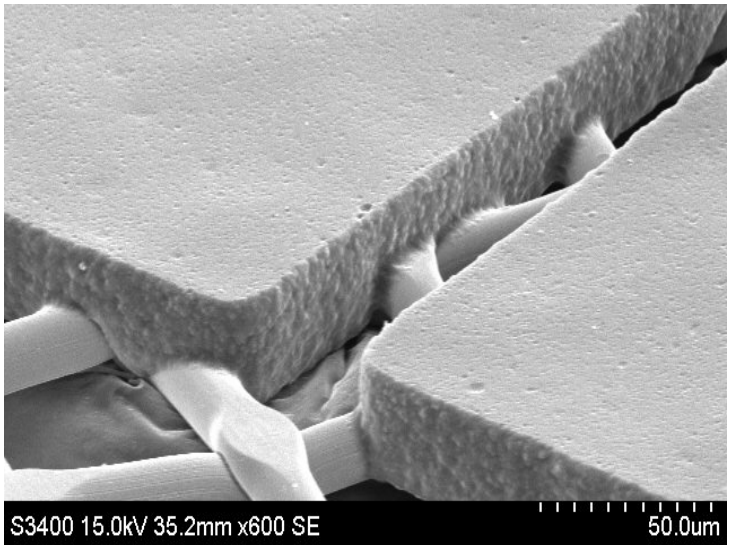
Result: 49.84 µm / 99.68 µm

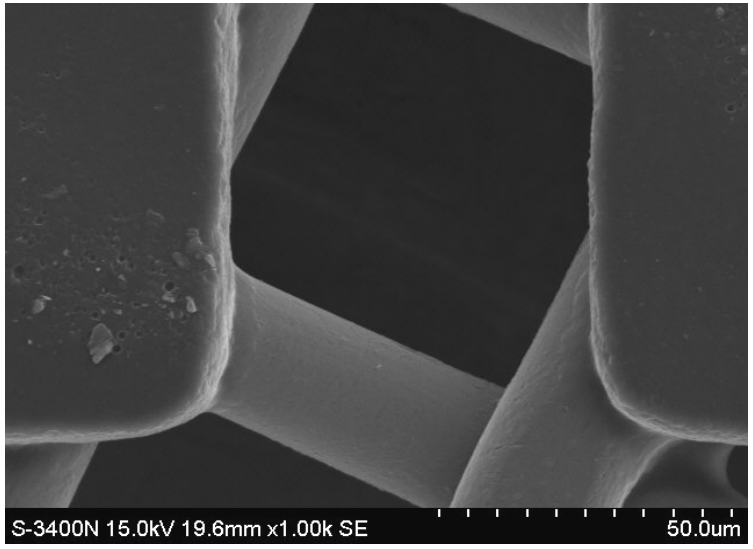


Scanning Electron Microscope (SEM)

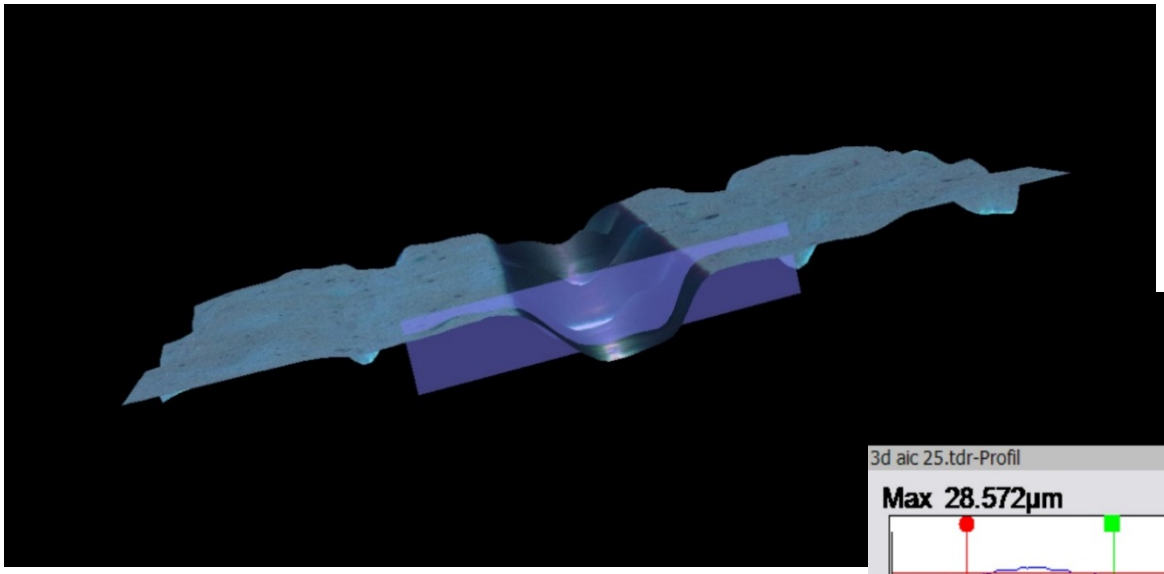


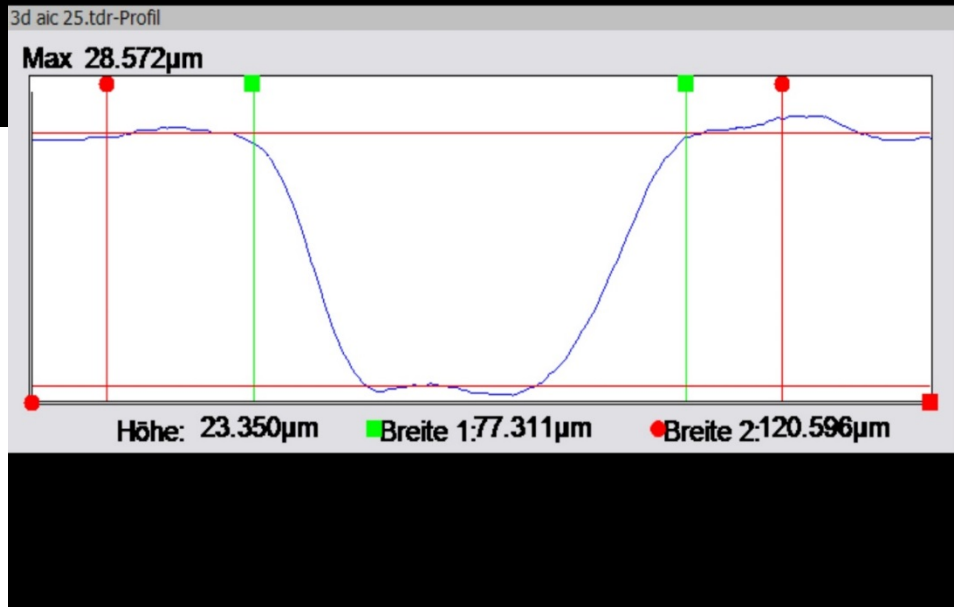






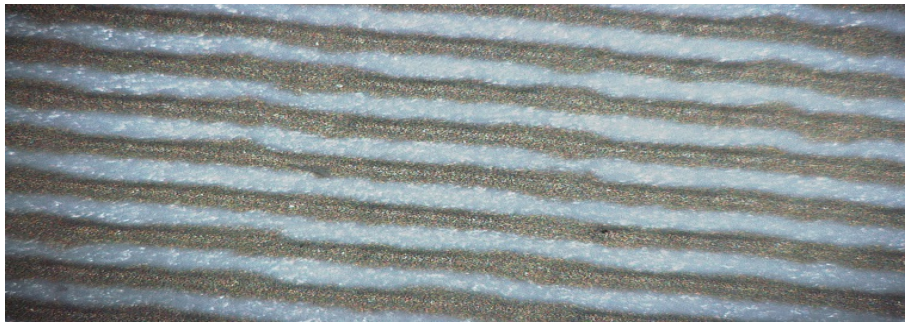
3-D laser measuring microscope & graph of emulsions printing channel



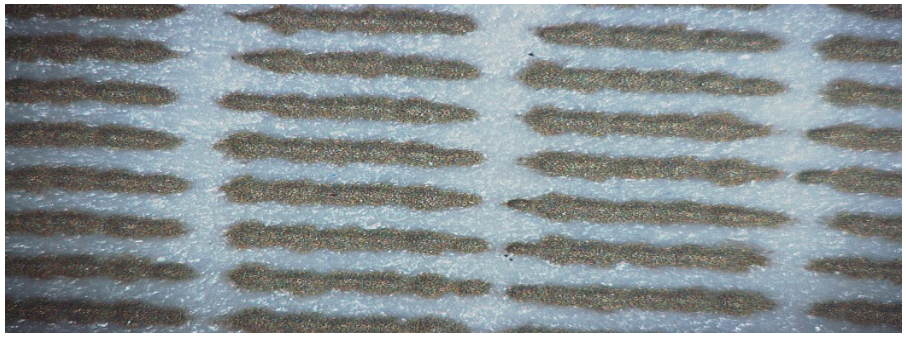


Reproduction Accuracy of 30 µm Ag Finger

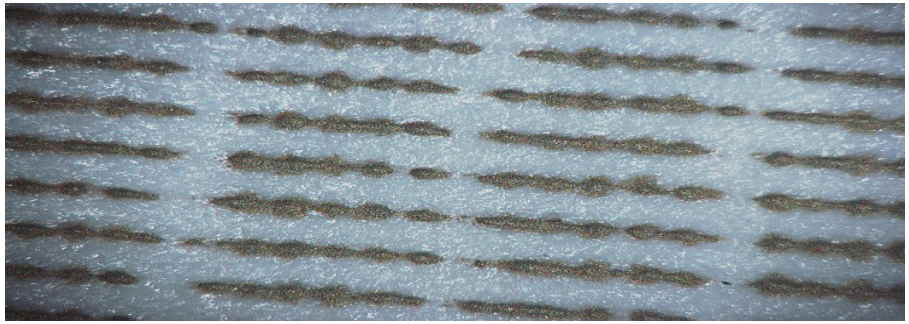
Emulsion A



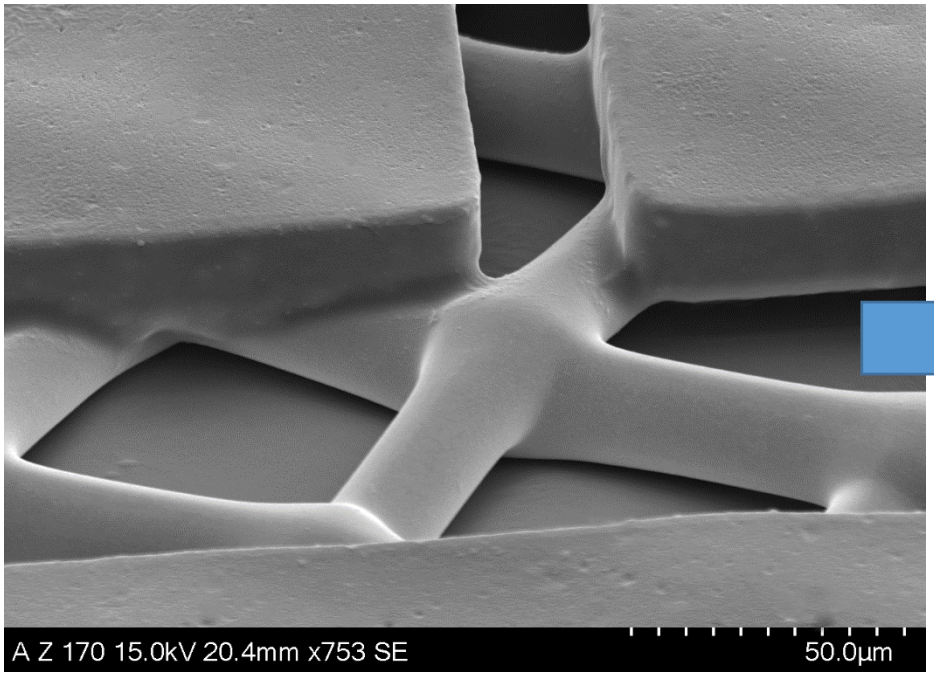
Emulsion B

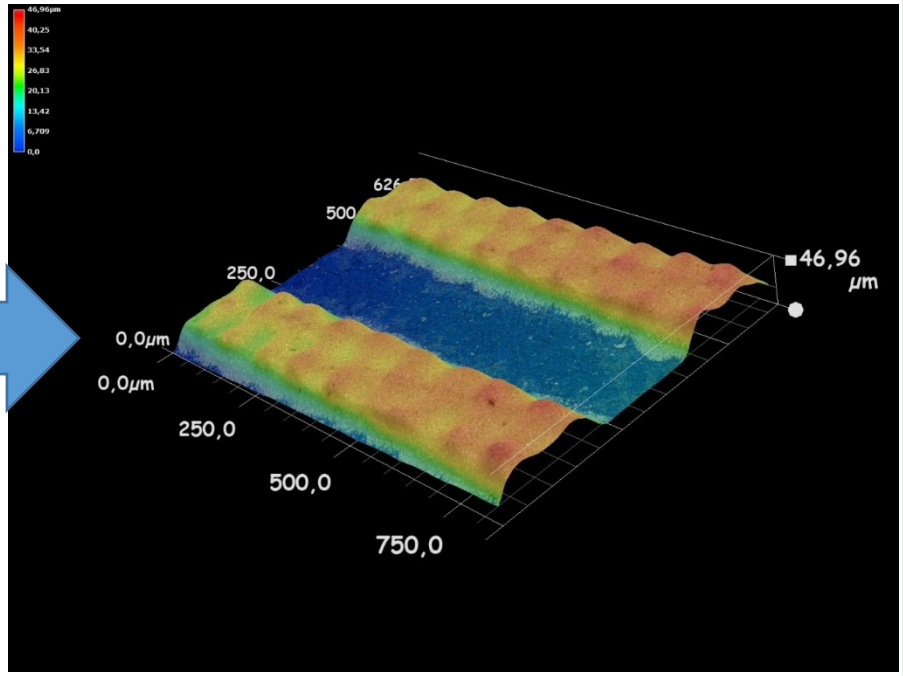


Emulsion C



Printed 30 µm finger
Very sharp, high aspect ratio

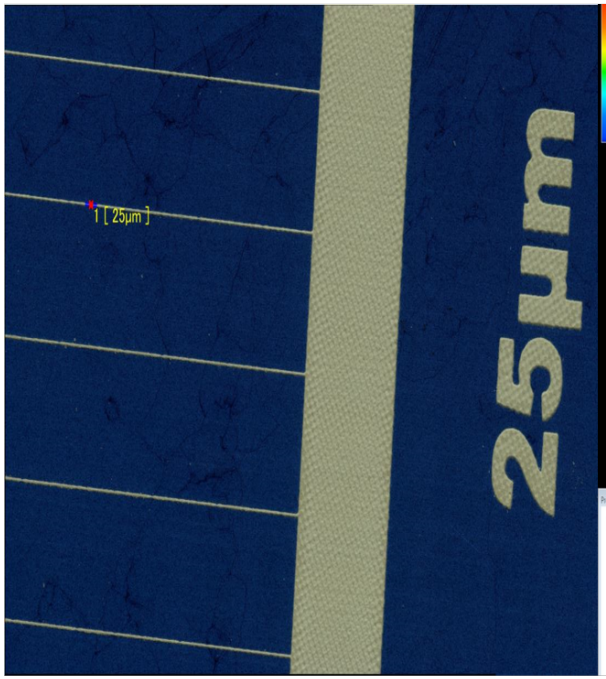




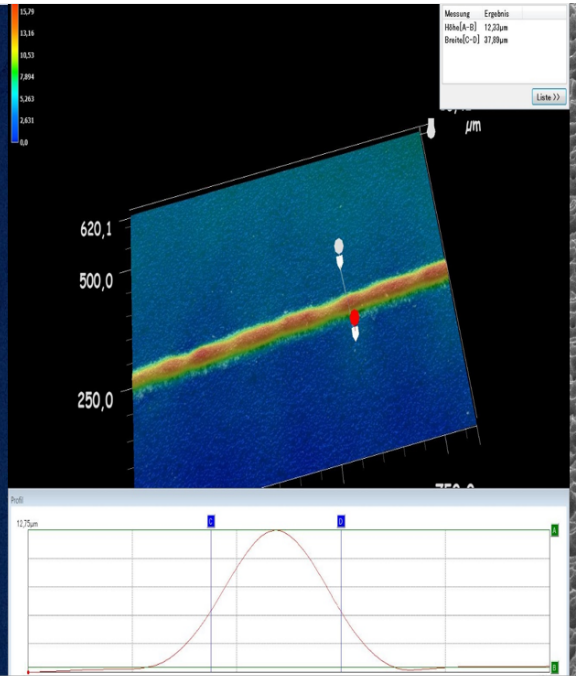
Fineline solar-printing (Ag paste)

Requirements: special treated mesh, special coating

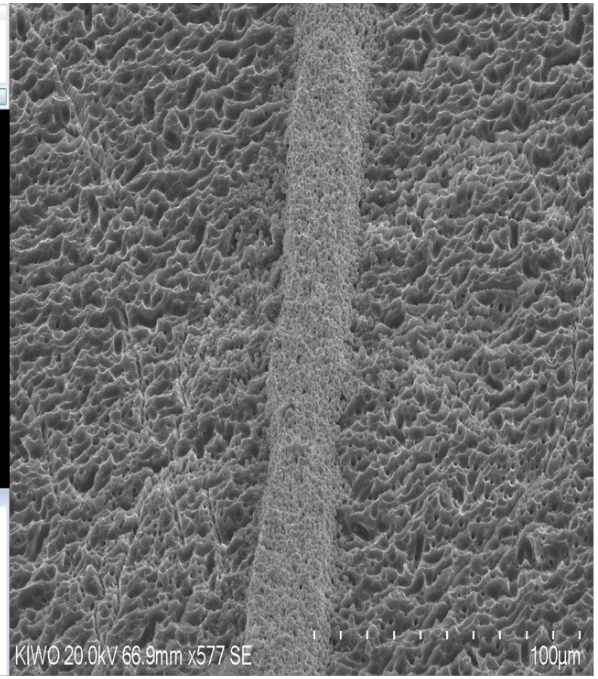
Result: 25 µm finger without interruptions



25 µm finger without interruptions



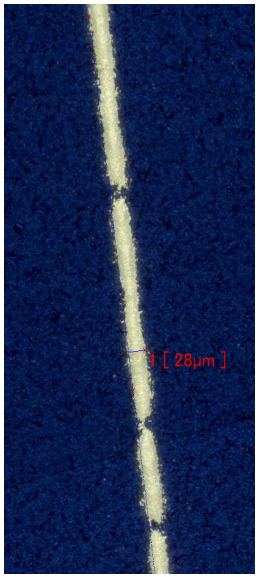
Very high aspect ratio.

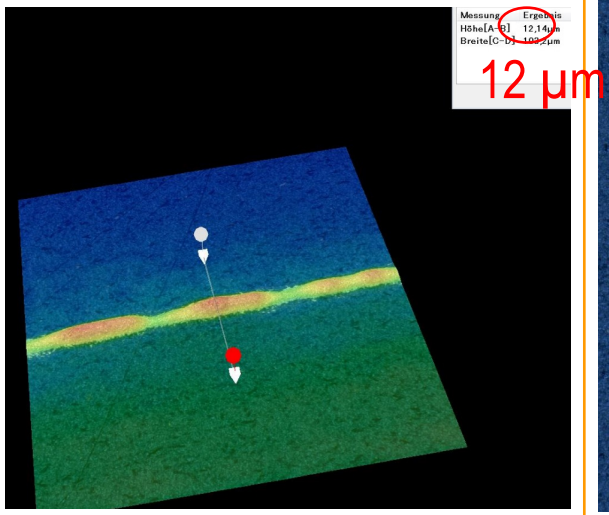


SEM-picture of printed silver conductor line

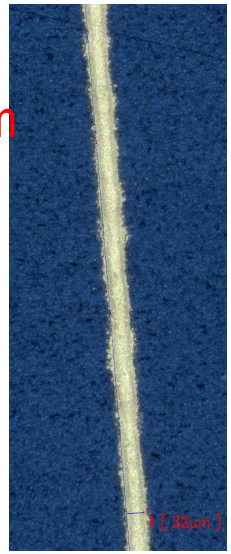
Printing Test – 25 Micron

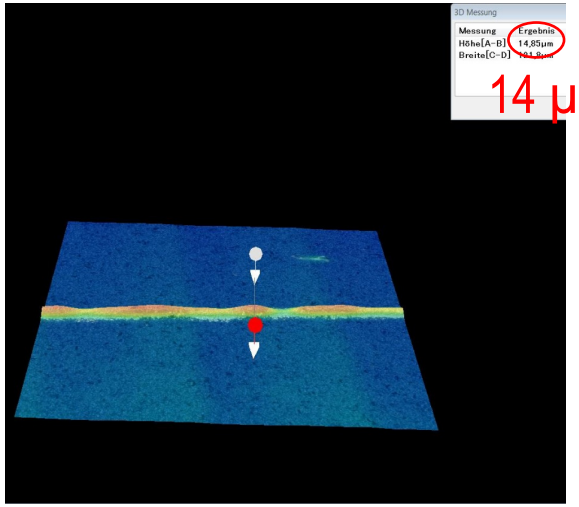
Without release agent



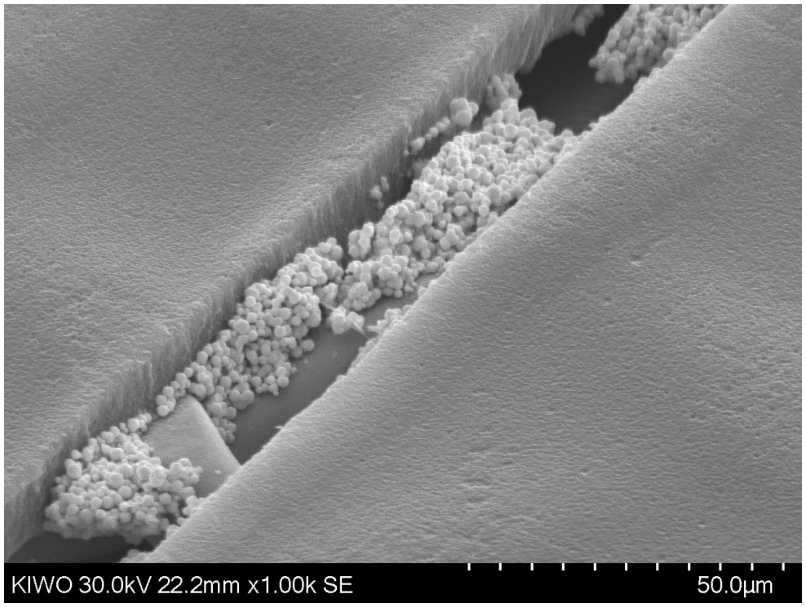


With release agent

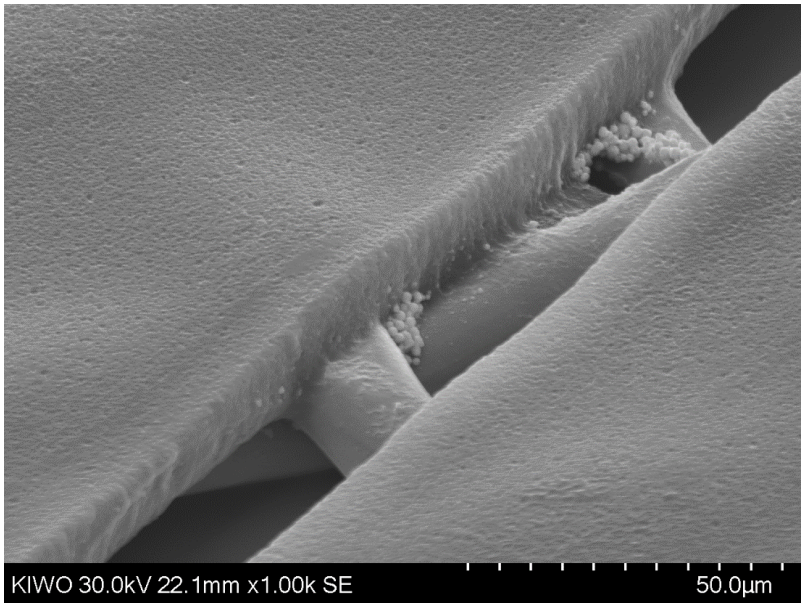




Without Release Agent



With Release Agent



Future Emulsions/ Films for PV and Electronics

