




Optimizing Chemical Milling

The Strategic Role of Dry Film in Metal Protection and Definition

In collaboration with
schmoll  maschinen
... one step ahead.

A grayscale microscopic image of a honeycomb-like structure, possibly a dry film or a biological tissue. The structure consists of interconnected hexagonal cells with thick, dark, ridged walls and lighter, smoother interiors. The perspective is from above, looking down into the cells.

Strategic Dry Film

Optimized
Processes

Sharper
Features

Exceptional
Results

Better
Yields

1. What is a Dry Film.
2. Different applications – Different Dry Films
3. Dry Film Composition
4. Dry Film production
5. Key Features of Dry Film
6. Processing conditions
7. Study on Different Materials
 - 7.1 Brass
 - 7.2 Stainless Steel Satin
 - 7.3 Stainless Steel 2B
 - 7.4 Stainless Steel BA Mirror
 - 7.5 Stainless Steel Supermirror (8K)
8. About Elga Europe. Technical Service

1. What is a Dry Film

Optimizing Chemical Milling

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8. About Elga Europe

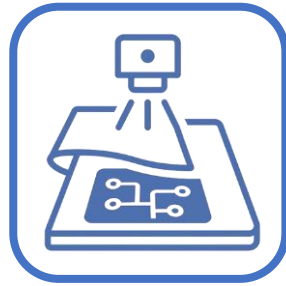


Dry Film

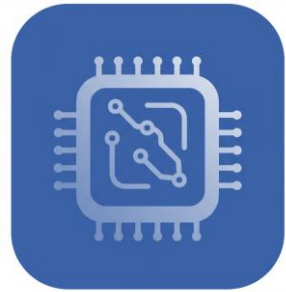
Photosensitive polymer that defines precise patterns on metal surfaces, acting as a protective mask during chemical milling, electroforming or PCB production

2. Different applications

Different Dry Films



PCB IMAGING



ULTRA HDI & IC SUBSTRATES













































































CHEMICAL MILLING



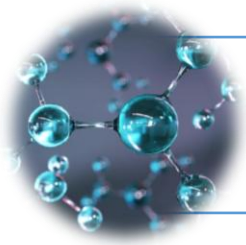
ELECTROFORMING

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Dry Film Applications	Exposition Machine		Application							Main Features & Properties							<div>ElgaEurope</div> <div>Living inside technology</div> <div>Reference values for:<ul style="list-style-type: none">40µm dry film thicknessDeveloping: 0.8% NaCO3 @ 28 °CStripping: 3% NaOH immersion @ 50 °C</div>
	 <div>CONVENTIONAL</div>	 <div>DIRECT</div>	 <div>PCB IMAGING</div>	 <div>ULTRA HDI IC SUBSTRATE</div>	 <div>CHEMICAL MILLING</div>	 <div>ELECTROFORMING</div>	 <div>ONE FOR ALL</div>	 <div>ALKALINE RESISTANT</div>	 <div>Au Ni</div>	 <div>CONFORMABILITY SOFTNESS</div>	 <div>ADHESION</div>	 <div>MATERIAL COMPATIBILITY</div>	 <div>ENERGY DEMAND/SPEED</div>	 <div>DEVELOPING SPEED</div>	 <div>STRIPPING SPEED</div>	 <div>PARTICLE SIZE</div>	
			++	-	+	-	+++	+++	+++	 <div>Soft</div>	 <div>High</div>	 <div>Copper Alloys</div>	 <div>Slow</div>				
			+++	-	++	++	-	-	-	 <div>Soft</div>	 <div>High</div>	 <div>Steel Copper Alloys</div>	 <div>Medium</div>				
			+++	-	++	++	++	++	++	 <div>Very Soft</div>	 <div>Very high</div>	 <div>Copper Alloys</div>	 <div>Fast</div>				
			+++	-	++	++	++	++	++	 <div>Very Soft</div>	 <div>Very high</div>	 <div>Steel Copper Alloys</div>	 <div>Very Fast</div>				
			+++	-	+++	-	-	-	-	 <div>Soft</div>	 <div>High</div>	 <div>Steel Copper Alloys</div>	 <div>Fast</div>				
			+++	-	+++	+++	+++	+++	+++	 <div>Soft</div>	 <div>High</div>	 <div>Steel Copper Alloys</div>	 <div>Slow</div>				
			+++	-	+++	++	++	++	++	 <div>Soft</div>	 <div>Very high</div>	 <div>Steel Copper Alloys</div>	 <div>Medium</div>				
			+	-	+++	+++	-	-	++	 <div>Soft</div>	 <div>High</div>	 <div>Steel Copper Alloys</div>	 <div>Very Slow</div>				

3. Dry Film Composition



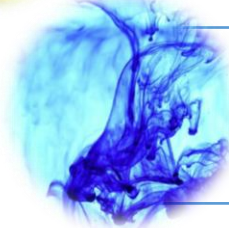
Polymer Matrix

Core structure of the Dry Film, responsible for photosensitivity and mechanical properties. When exposed to UV light, they initiate a polymerization reaction



Solvents

control the viscosity of the film, aiding smooth application to the PET carrier and ensuring uniform thickness



Dyes and colorants

help visually differentiate exposed and unexposed areas during processing for ensuring accurate alignment and inspection.



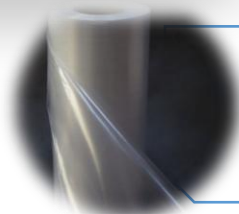
Additives and Modifiers

- **Adhesion Promoters:** ensure adhesion to the copper substrate
- **Plasticizers:** improve the flexibility of the Dry Film
- **Stabilizers:** provide chemical and UV stability
- **Anti-oxidants:** prevent unwanted oxidation reactions



Photoinitiators

initiate the curing process during the exposure to UV light to ensure the polymer hardens only in the areas exposed to light



Adhesion and protective layers

prevent contamination and damage during handling and storage. An adhesion layer facilitates bonding between the film and copper during lamination.

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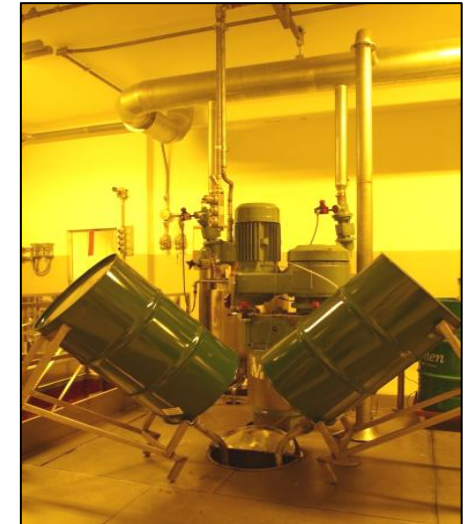
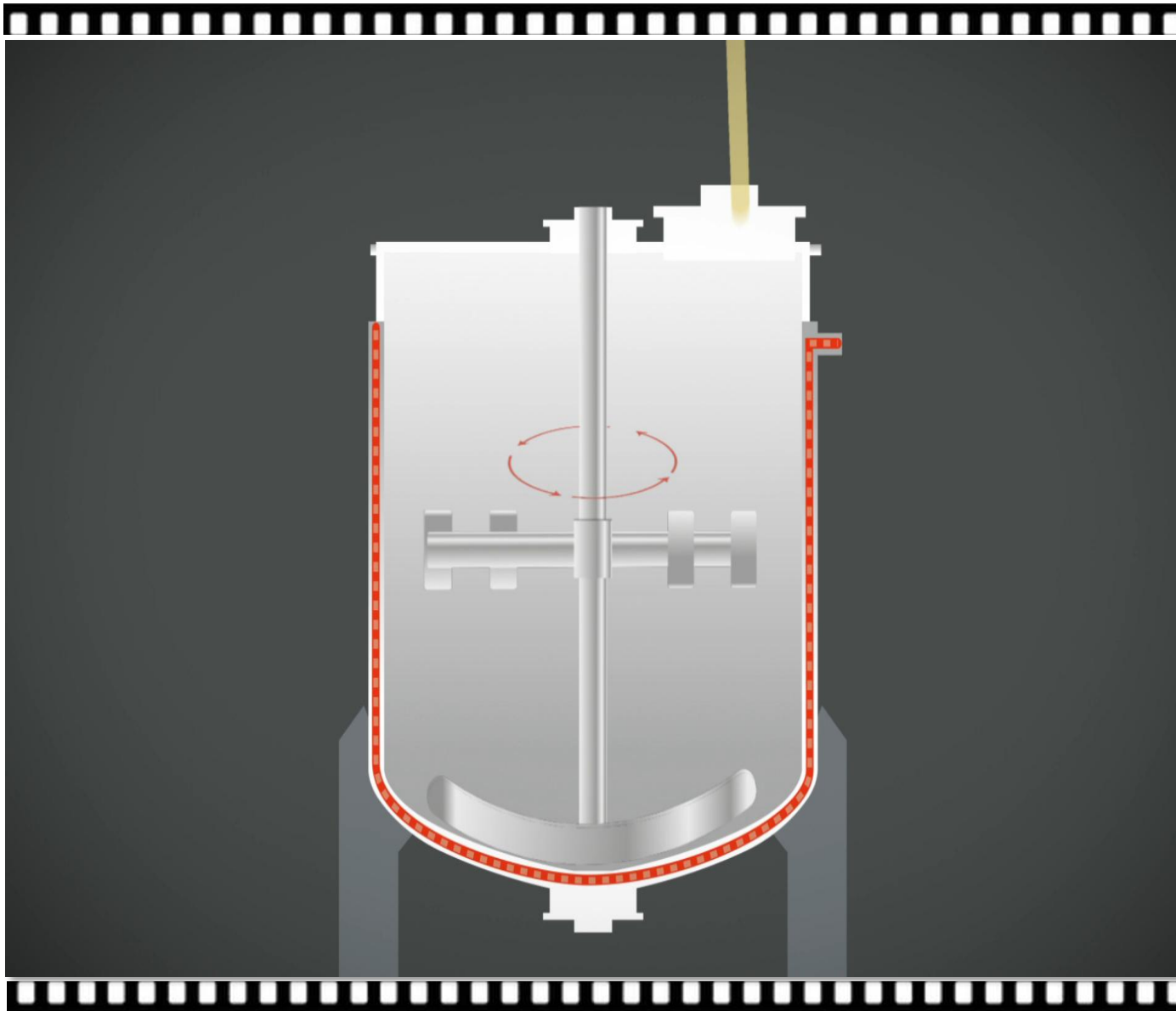
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8. About Elga Europe



4. Dry Film production

Optimizing Chemical Milling

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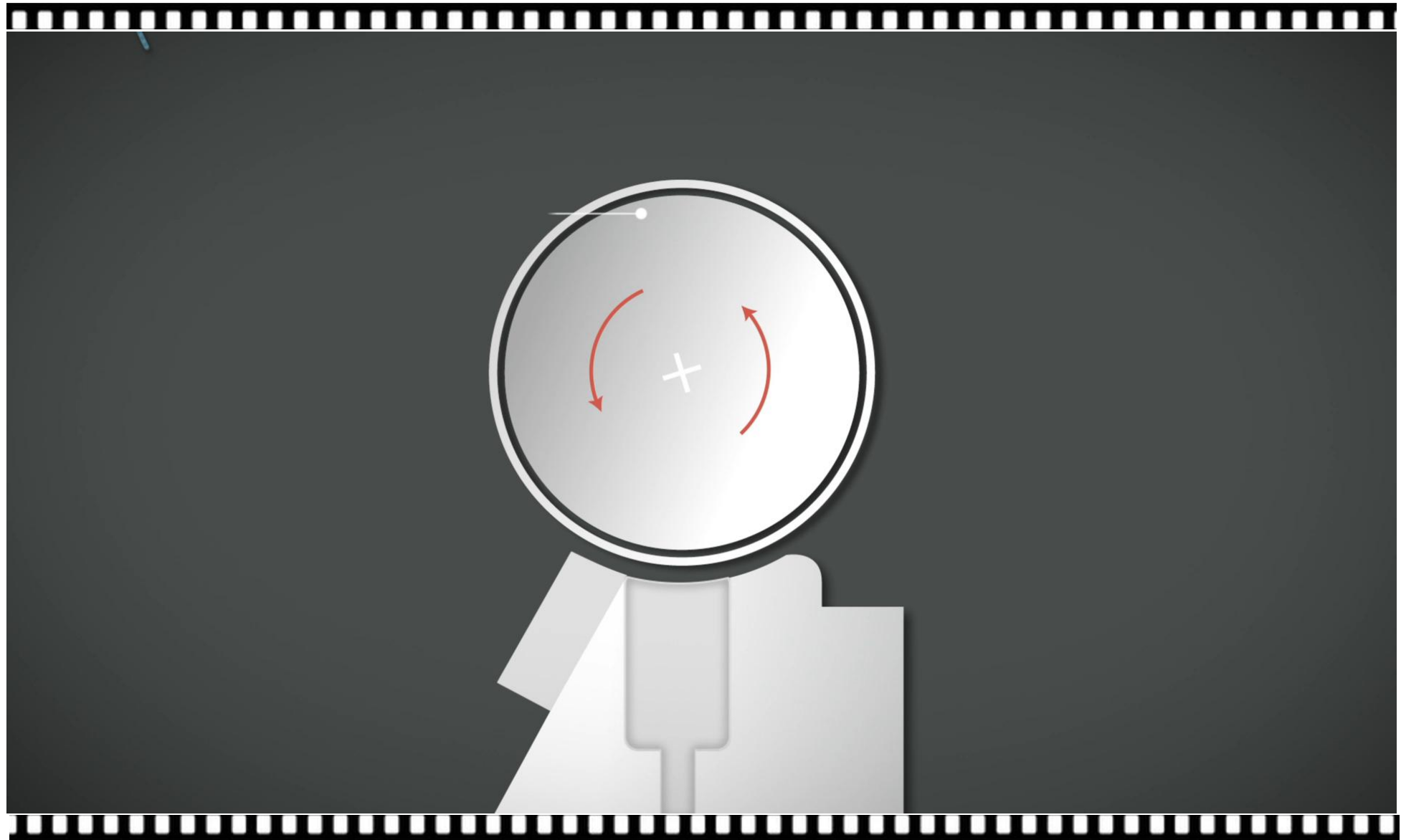
Polymer transfer



Liquid resist storage

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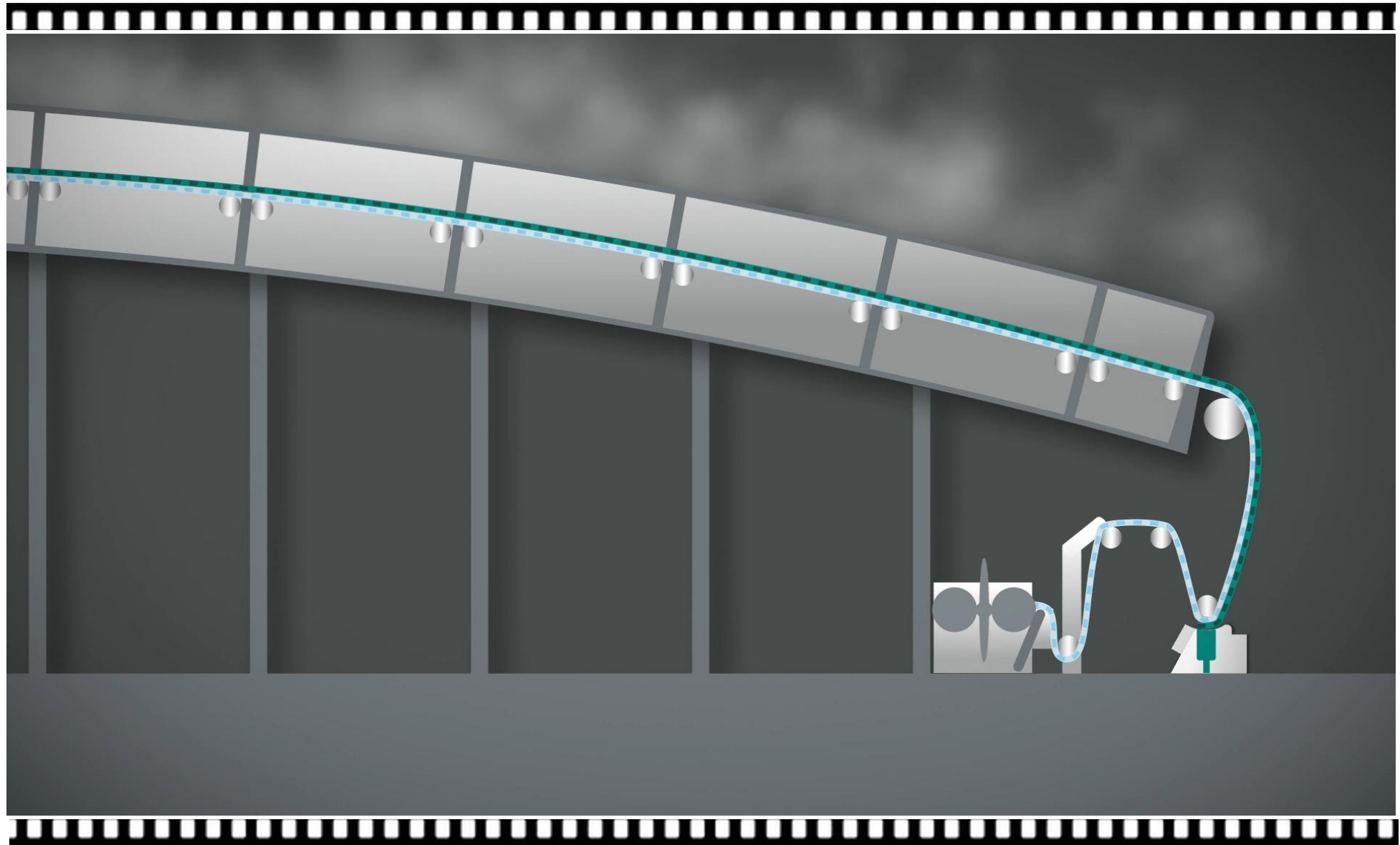
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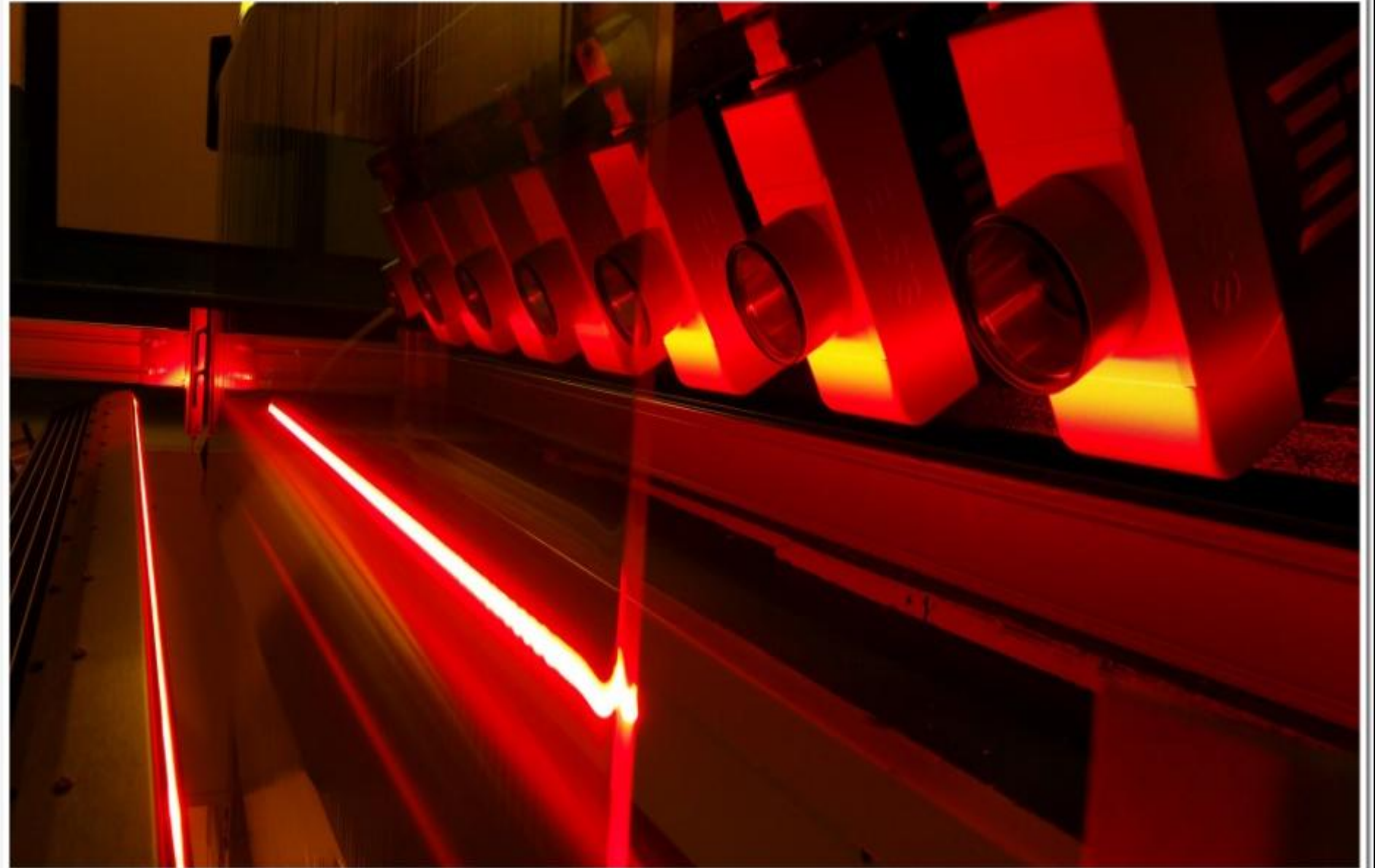
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DRYING and PE COUPLING



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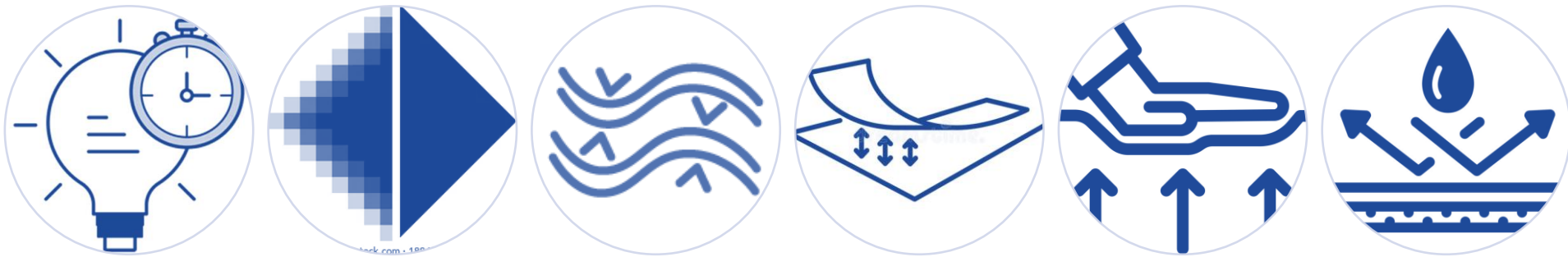


5. Key Features of Dry Film

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KEY FEATURES

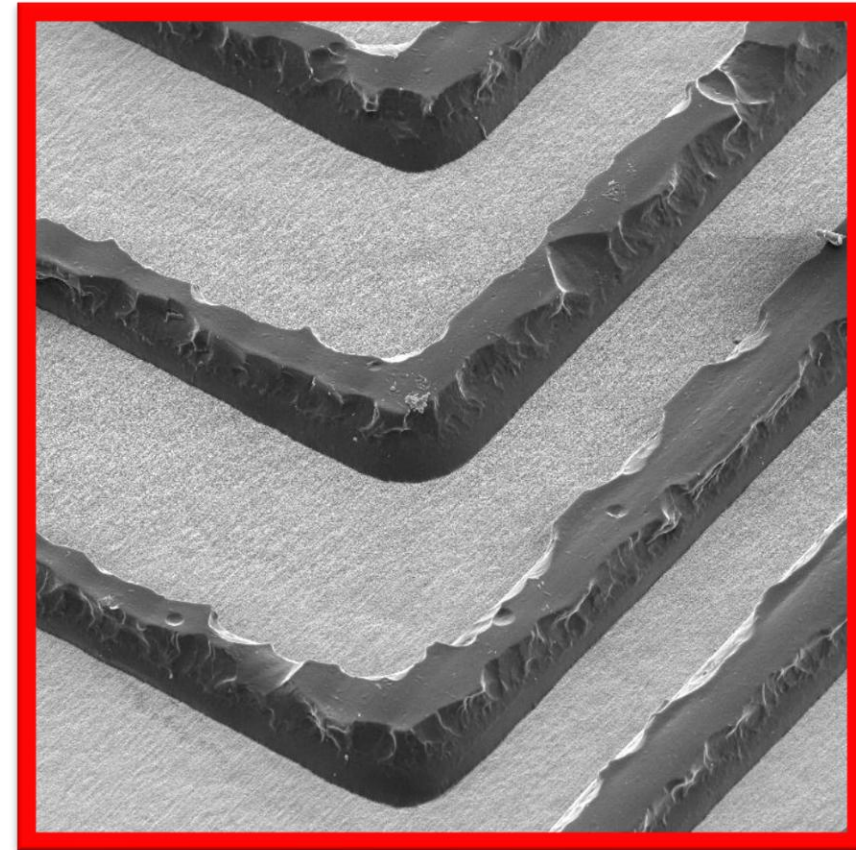
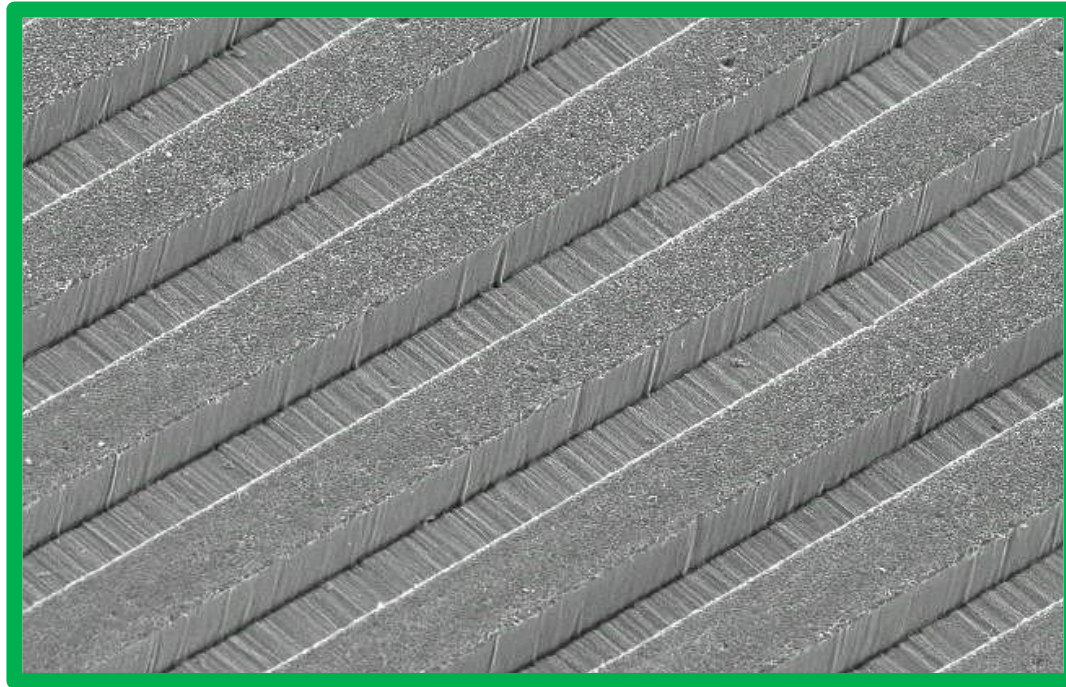


KEY FEATURES



Photosensitivity

The material reacts to UV light, hardening in exposed areas, which allows the unexposed sections to be easily removed in the developing process



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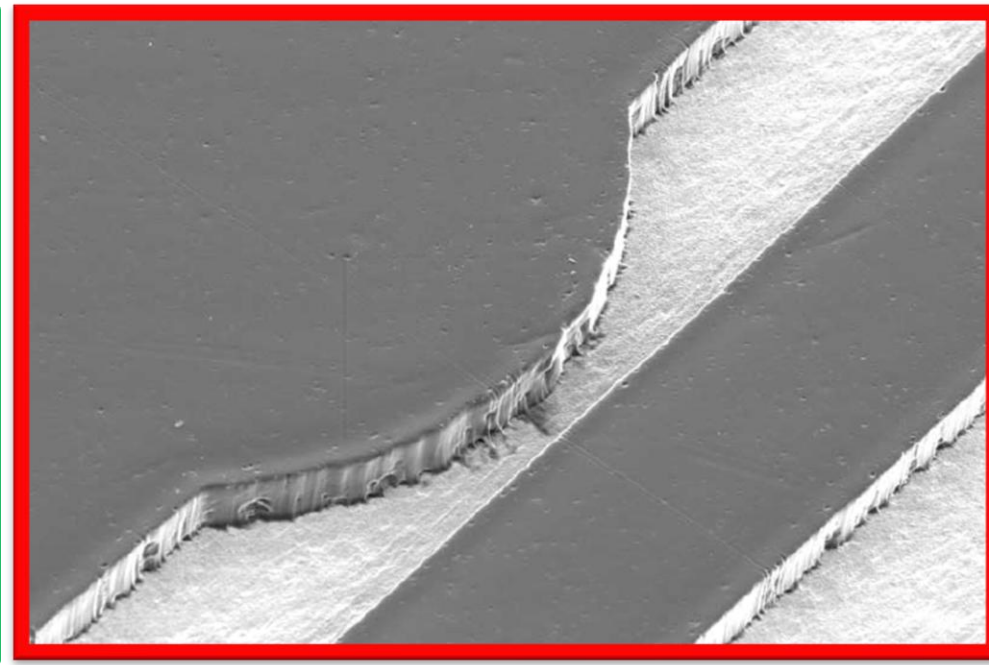
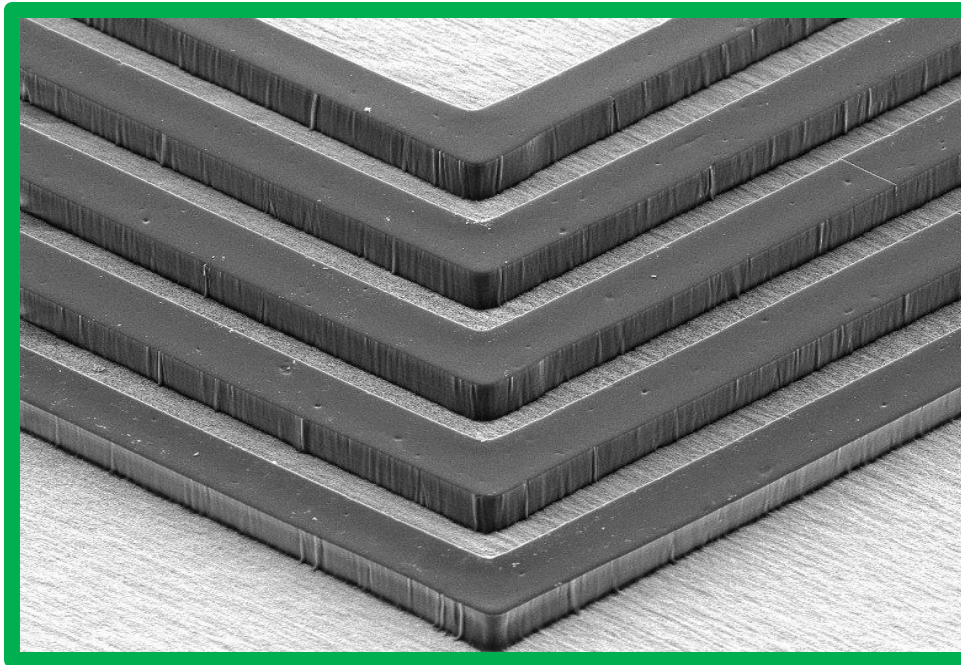


Resolution

Support fine line resolution and tight spacing between features. Our product offers superior resolution, capable of defining lines below 10 microns

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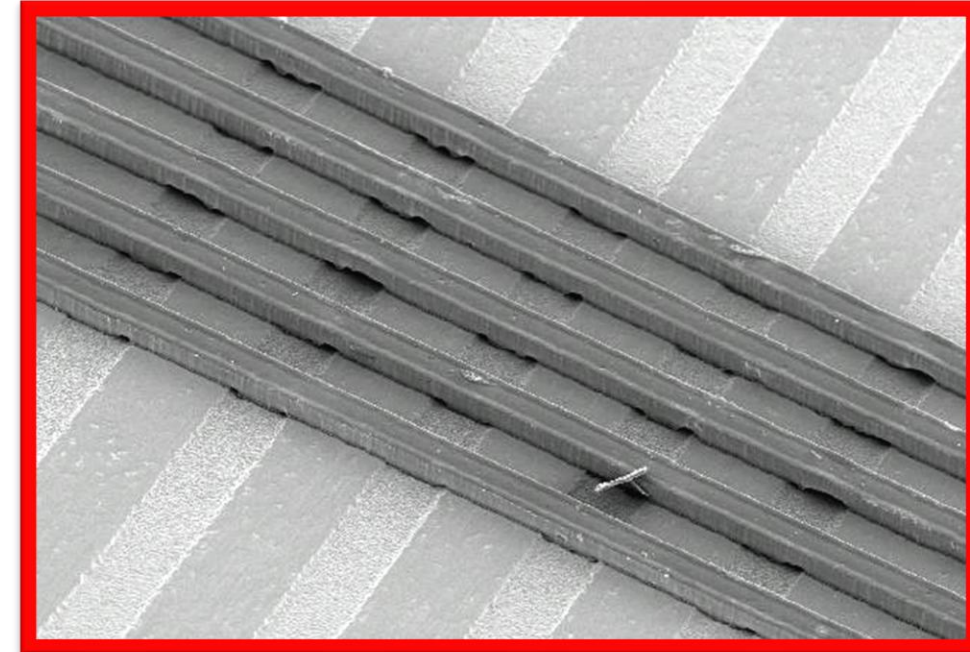
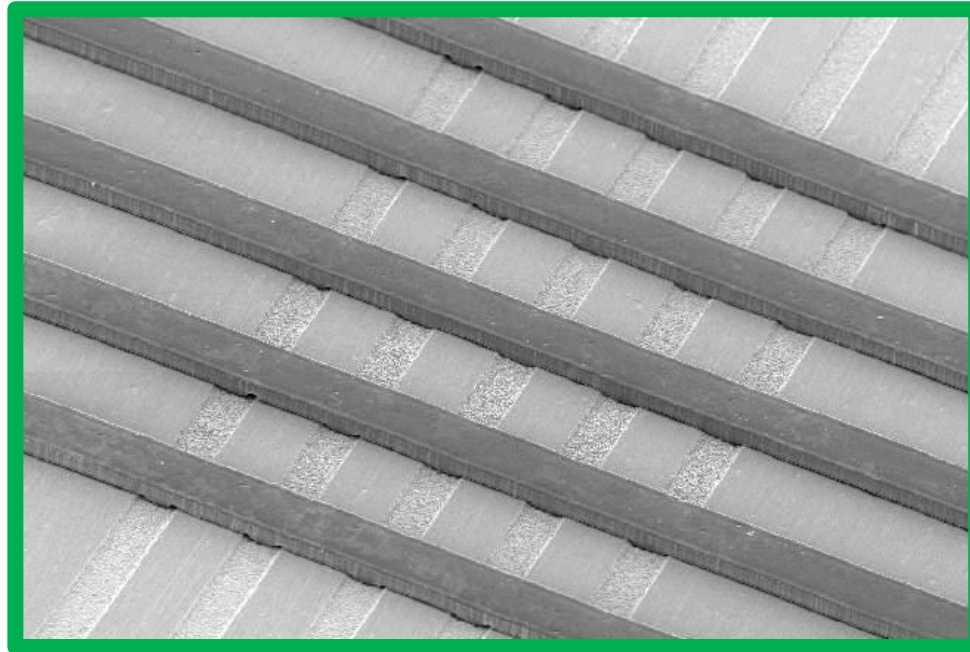
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8. About Elga Europe





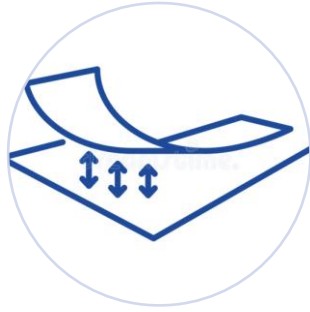
Conformability

Ability of the film to smoothly adapt and adhere to the substrate's surface, including irregularities, ensuring uniform coverage and minimizing defects.



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8. About Elga Europe

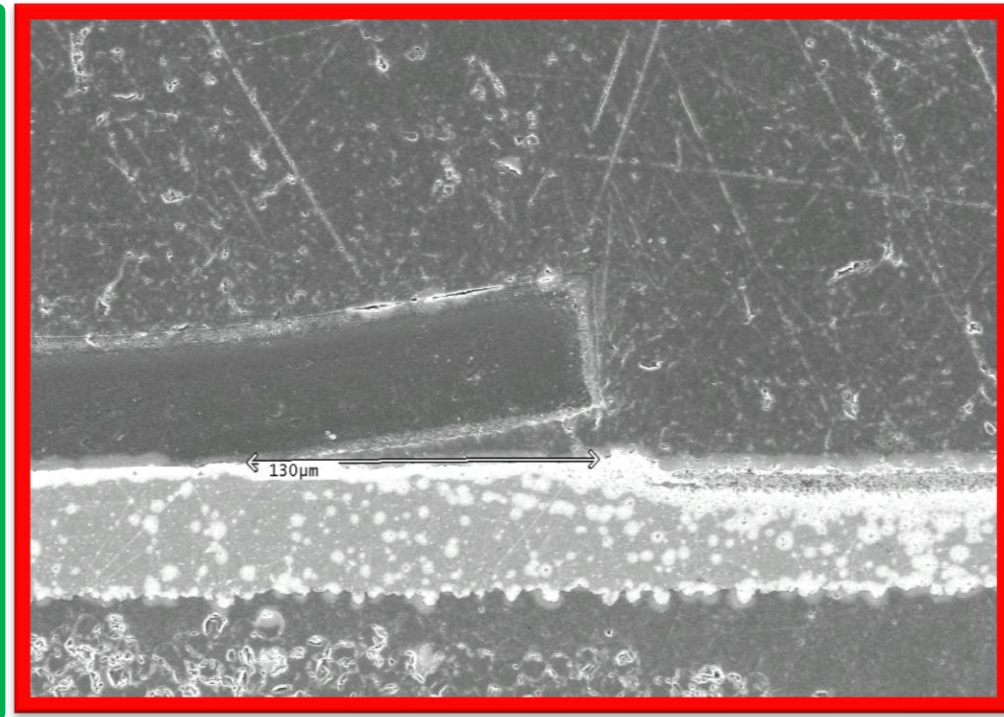


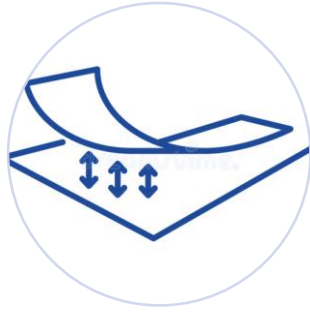
Adhesion

Our Dry Film is optimized for excellent adhesion on different substrates, reducing the risk of lifting, under-etching or delamination.

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8. About Elga Europe



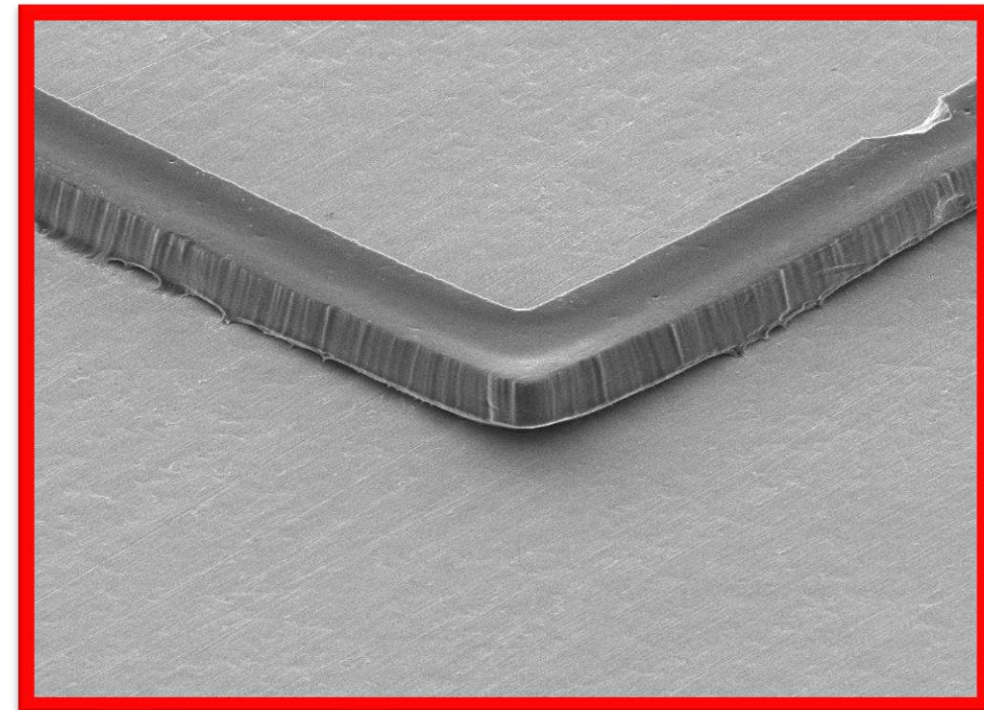
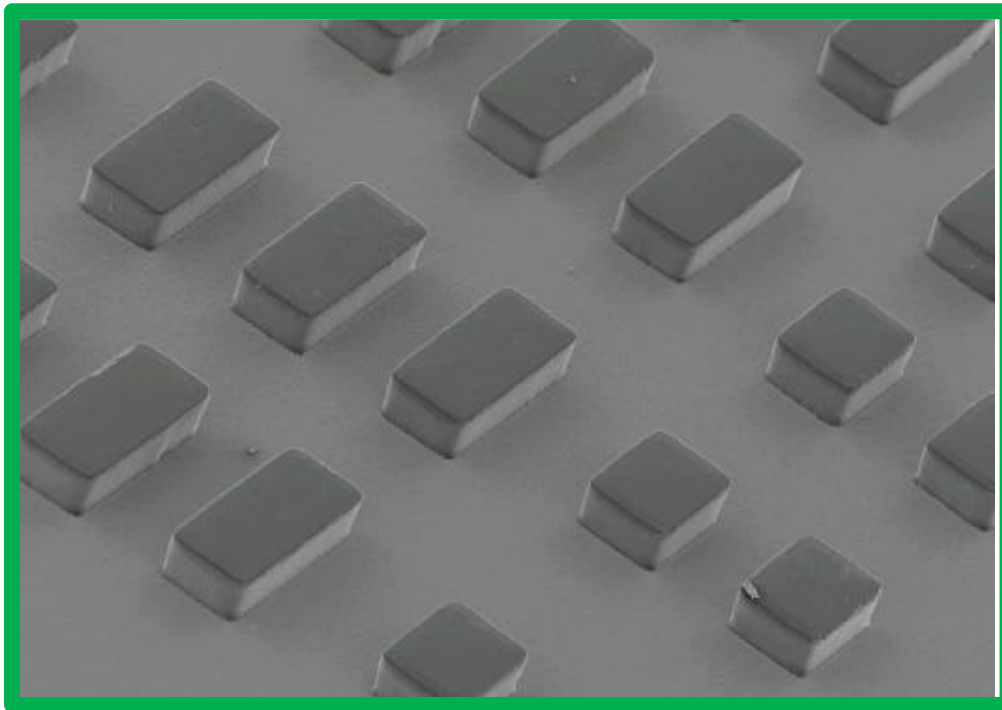


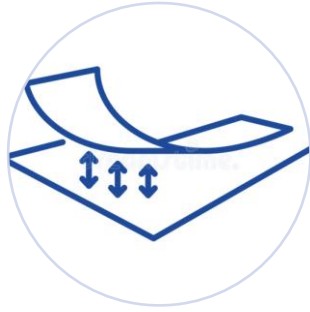
Mechanical properties

Strength, flexibility, and resistance to cracking or tearing during lamination, patterning, and development processes, ensuring structural integrity.

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8. About Elga Europe



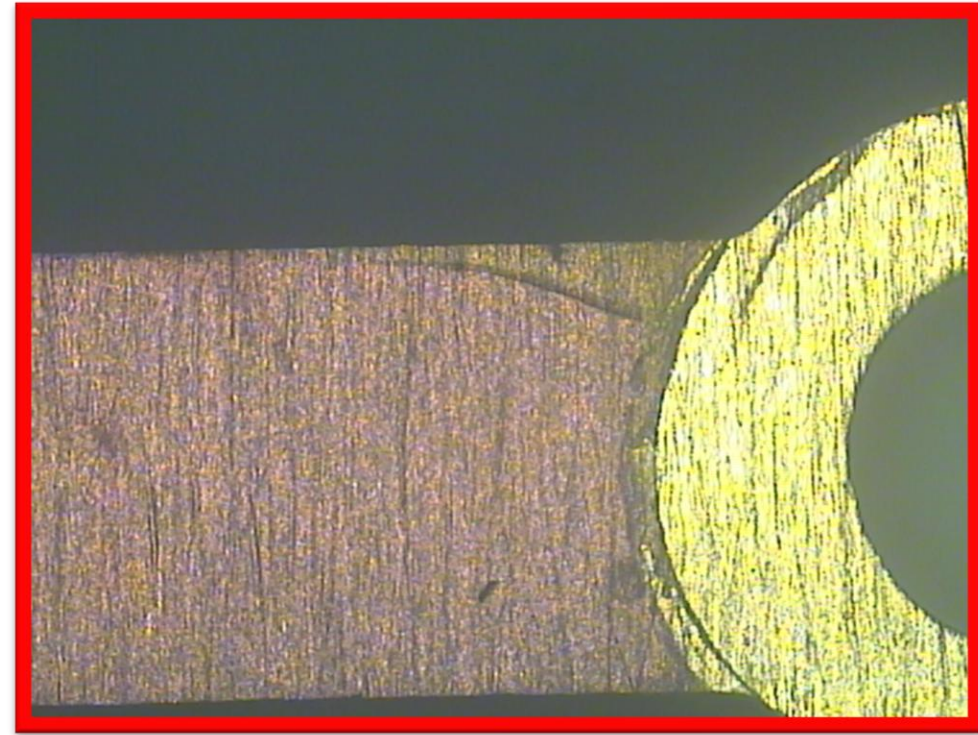
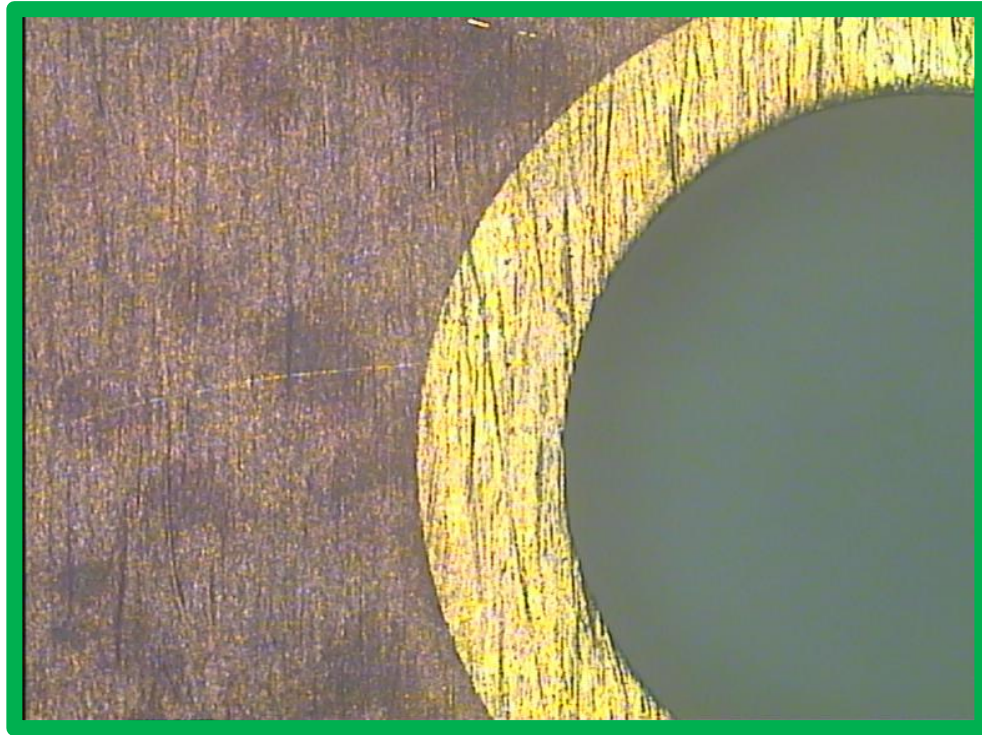


Chemical Resistance

The film remains stable and does not degrade or release any contaminants during the subsequent processes like plating or etching, maintaining integrity

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8. About Elga Europe

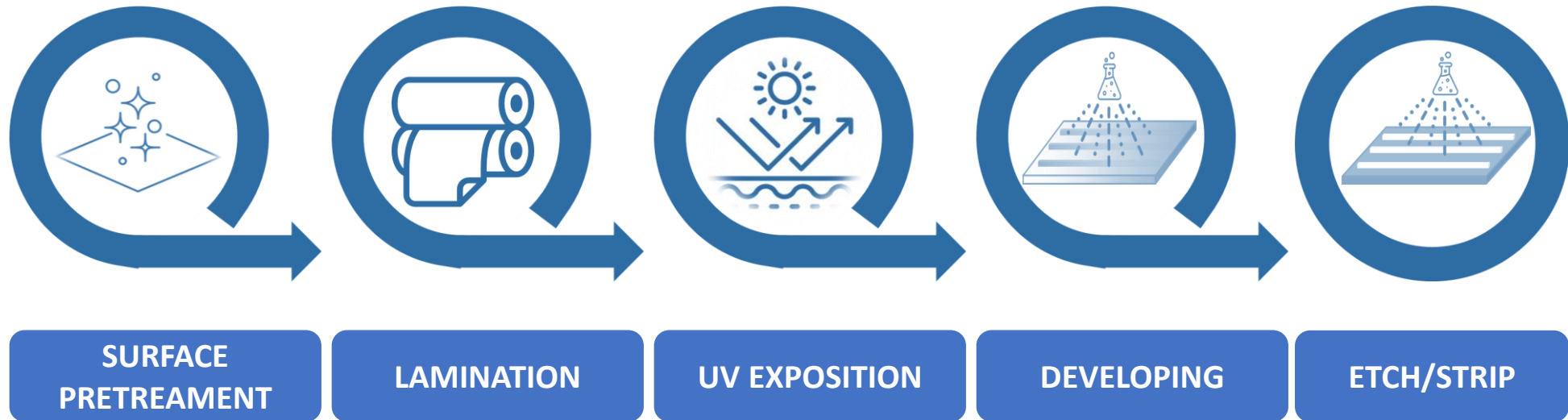


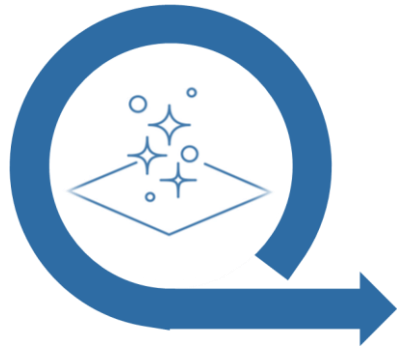
6. Processing conditions

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PROCESSING INFLUENCES





SURFACE PRETREATMENT

Influencing parameters

☐ Type of pretreatment



Mechanical
(Brushing)



Chemical
(Generic)



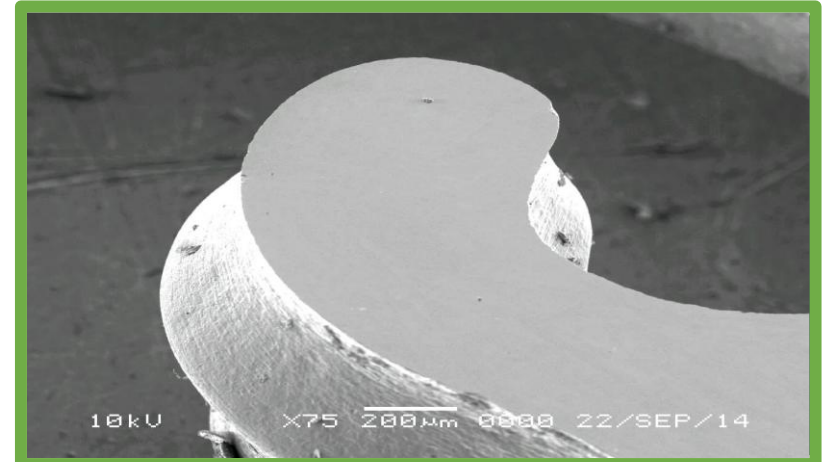
Chemical
(Specialty)

☐ Etch rate (if chemical)

☐ Pressure & Rolls type

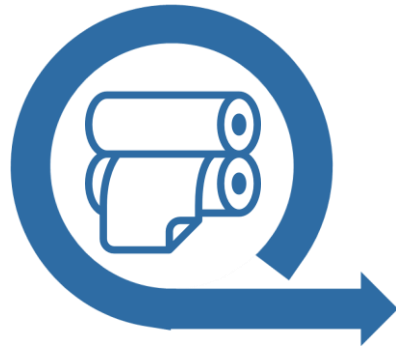
☐ Drying

☐ Storage



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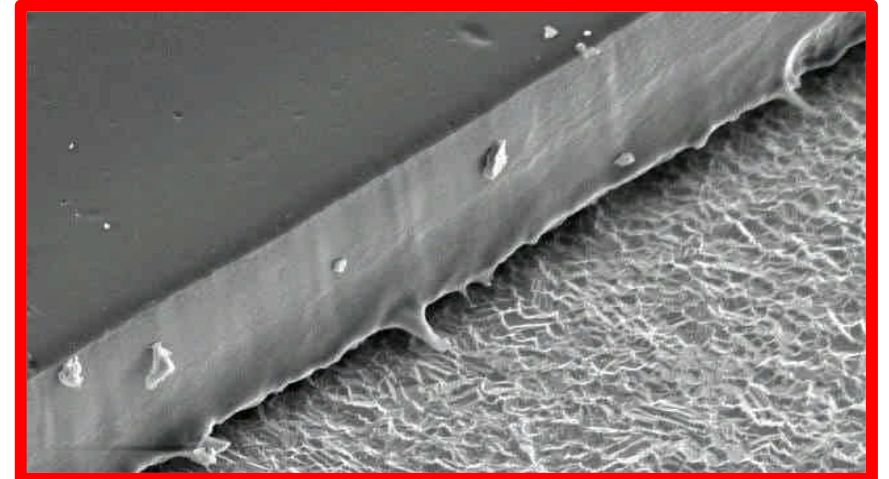
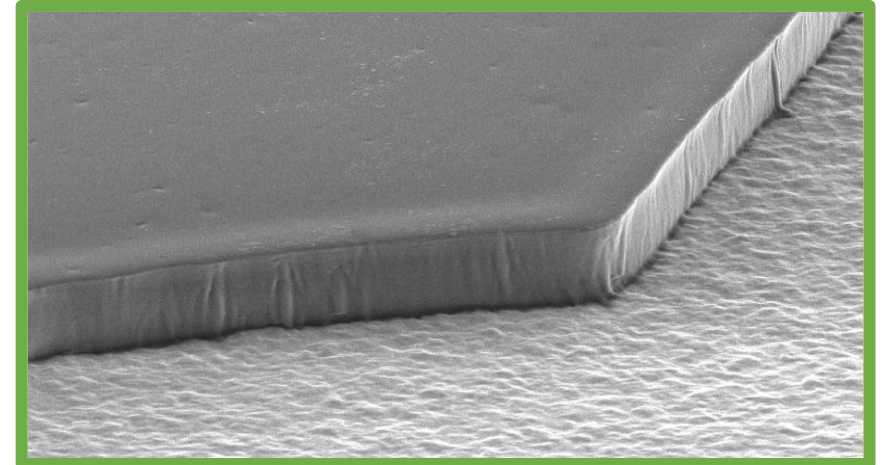
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DRY FILM LAMINATION

Influencing parameters

- ☐ Entry Temperature
- ☐ Roll Pressure
- ☐ Roll Temperature
- ☐ Tack Time
- ☐ Tack Temperature
- ☐ Speed
- ☐ Vacuum (for vacuum laminator)
- ☐ Exit Temperature



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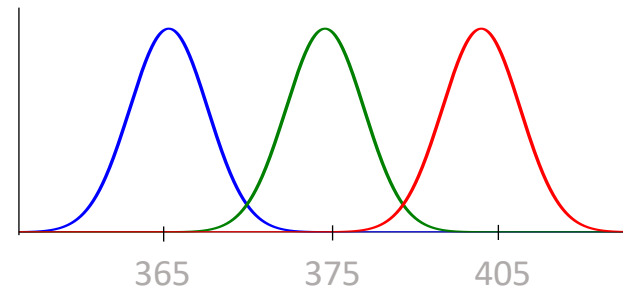
DRY FILM EXPOSITION

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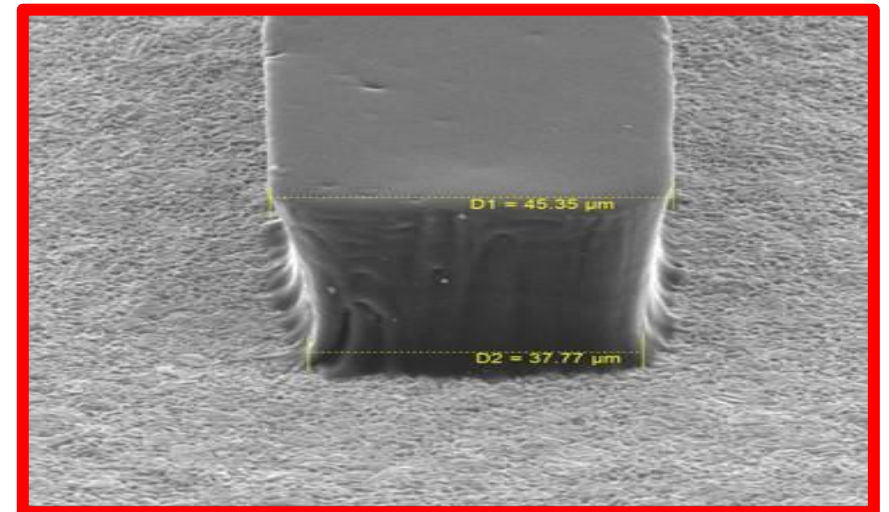
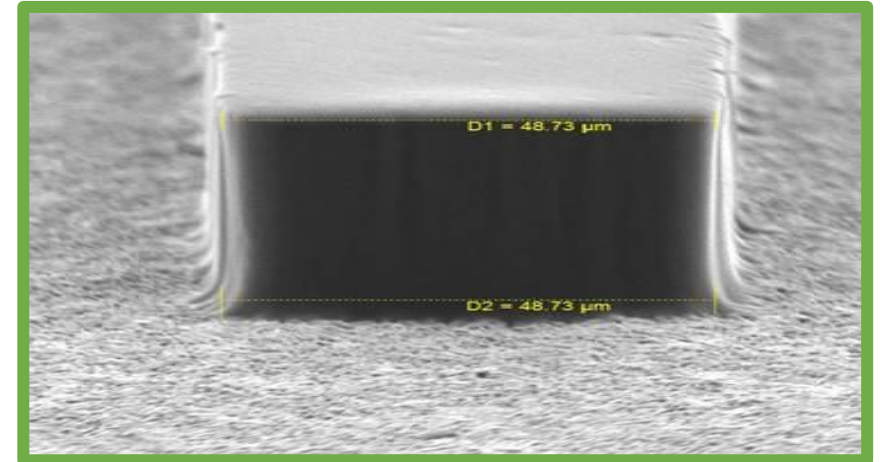
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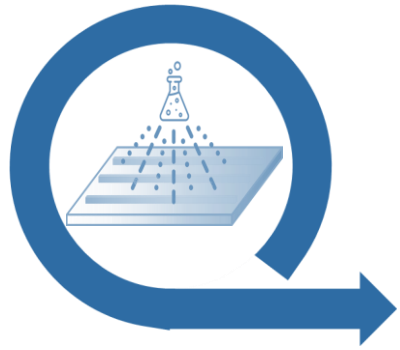
Influencing parameters

- ☐ Energy
- ☐ Wavelength composition



- ☐ Vacuum
- ☐ Overall cleanliness and maintenance





DEVELOPING

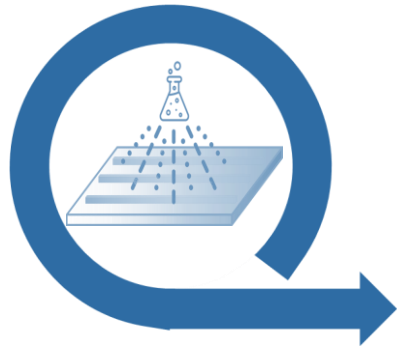
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Influencing parameters

- ☐ Carbonate concentration
- ☐ Temperature
- ☐ Contact time
- ☐ Spray pressure
- ☐ Break point
- ☐ Load factor





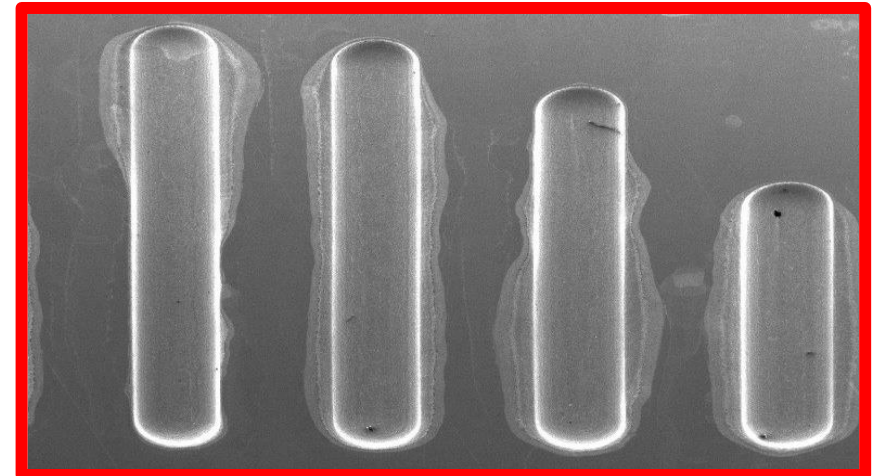
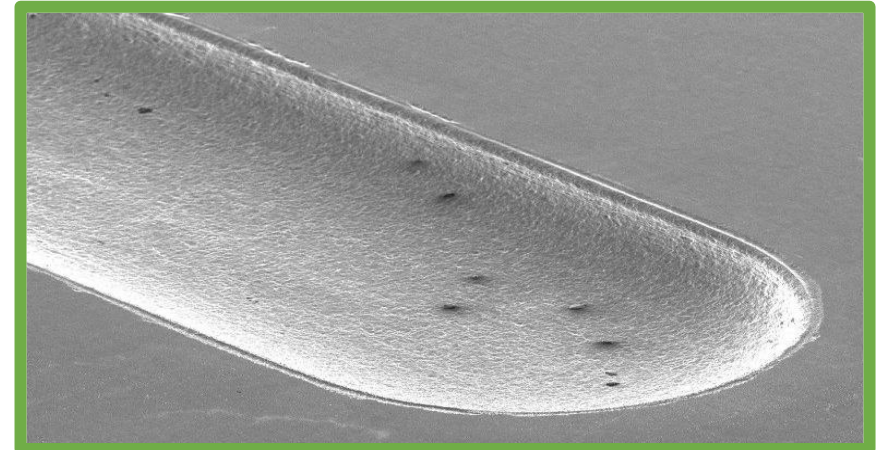
ETCH & STRIP

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Influencing parameters

- ☐ Etching Type
- ☐ Chemical profile
- ☐ Contact time
- ☐ Pressure & Oscillation
- ☐ Stripper type
- ☐ Contact time
- ☐ Break Point



7. Study on Different Materials

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5. Key Features of Dry Film
6. Processing conditions

7. Study on Different Materials

- 7.1 Brass
 - 7.2 Stainless Steel Satin
 - 7.3 Stainless Steel 2B
 - 7.4 Stainless Steel BA Mirror
 - 7.5 Stainless Steel Supermirror (8K)
8. About Elga Europe

DIFFERENT MATERIALS – DIFFERENT DRY FILMS



BRASS



INOX SATIN



INOX 2B



**INOX
BA MIRROR**



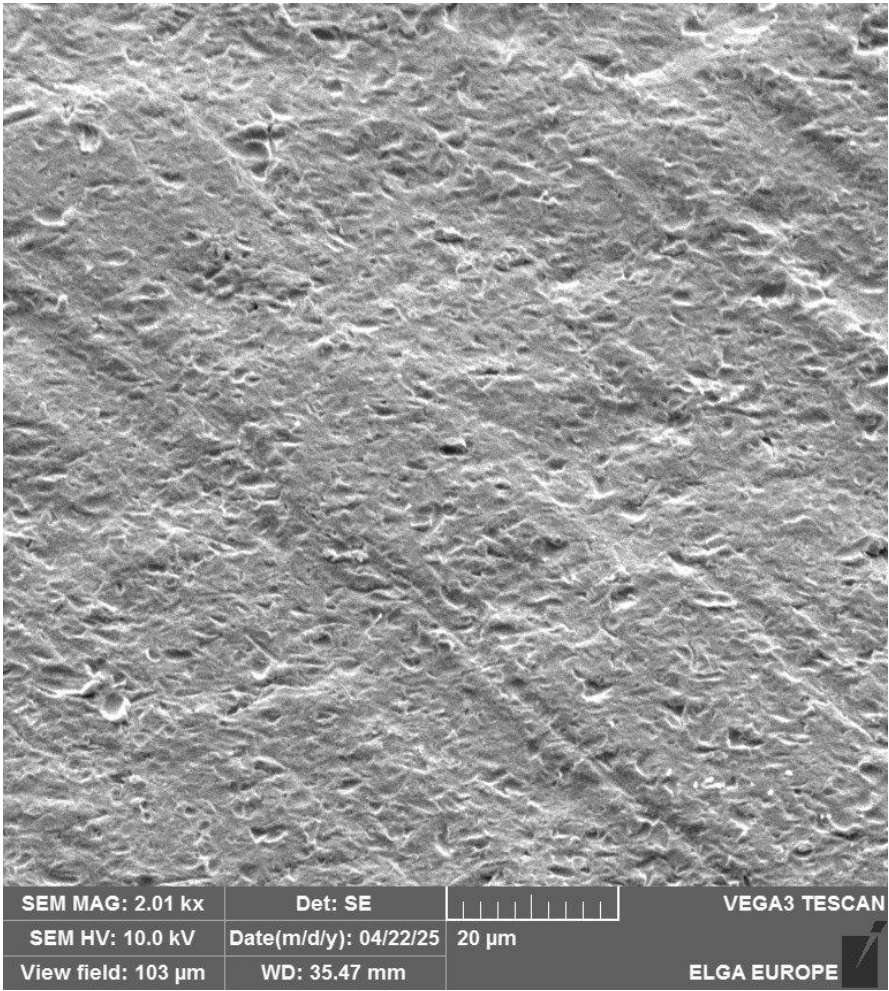
**INOX
SUPERMIRROR**

Optimizing Chemical Milling

- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
- 6. Processing conditions
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- 8. About Elga Europe



BRASS



- ❑ Copper-zinc alloy, soft and shiny
- ❑ Common for decorative plates and labels



- ❑ **Lamination:** Good adhesion if clean
- ❑ **Exposure:** Reflections. Contrast reduced
- ❑ **Developing:** Stains if exposure is weak
- ❑ **Etching:** Chemical sensitivity. Overetch
- ❑ **Stripping:** Stains if not neutralized



- ❑ Multipurpose DF (38 – 75 µm)
- ❑ Adh. promoter

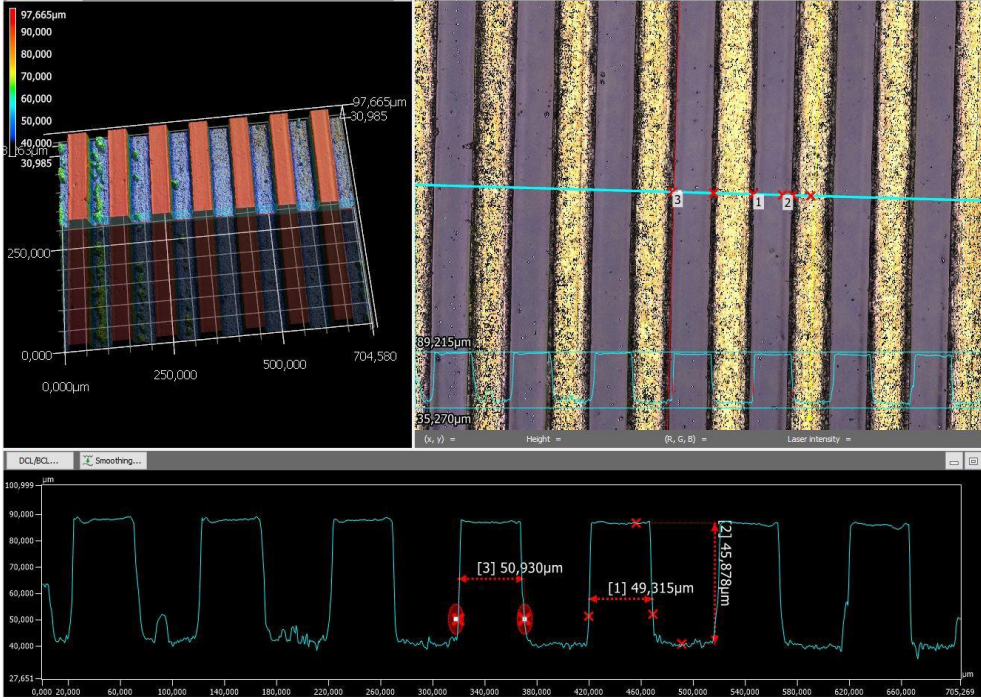
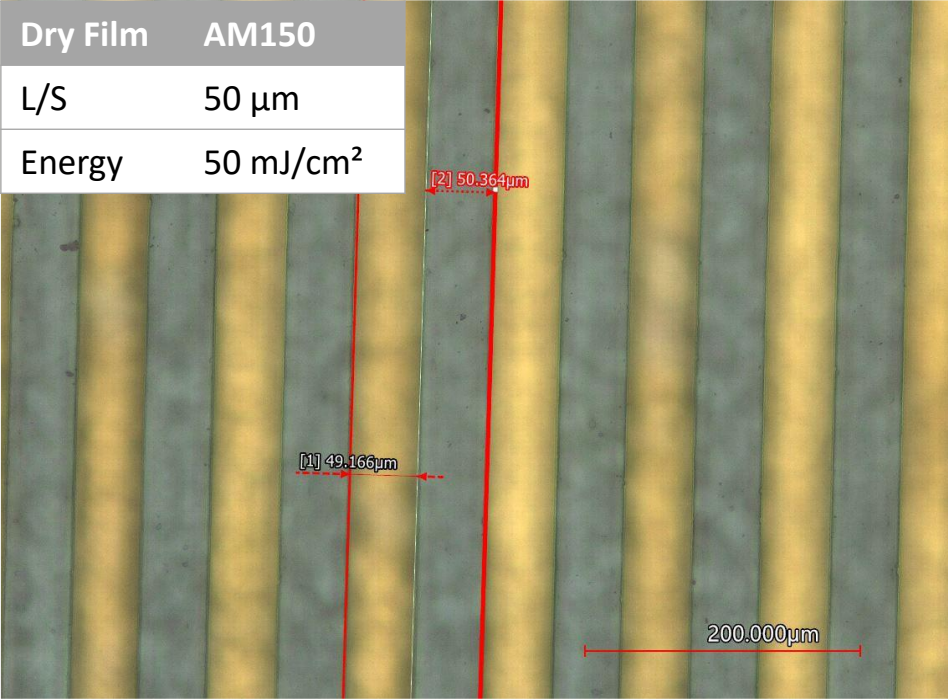
ORDYL® AM 100



BRASS

Optimizing Chemical
Milling

- 1. What is a Dry Film.
- 2. Different applications
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- 8. About Elga Europe

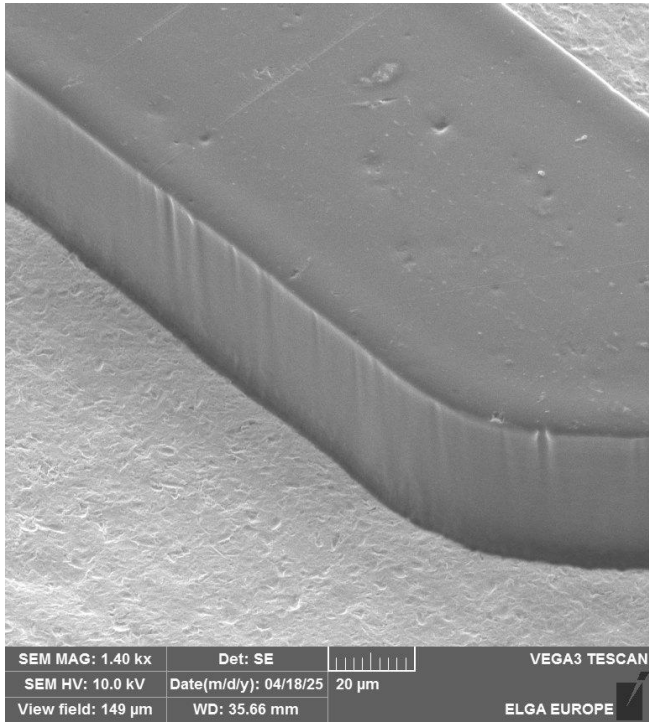
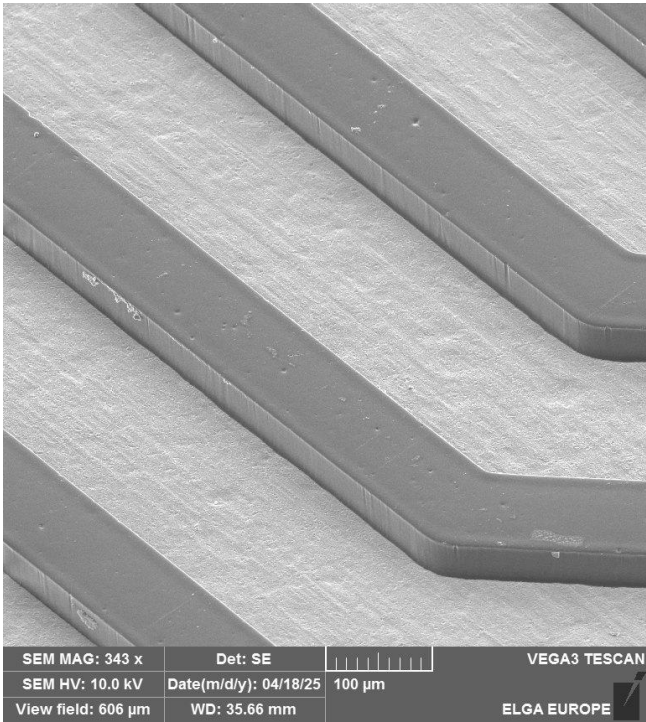
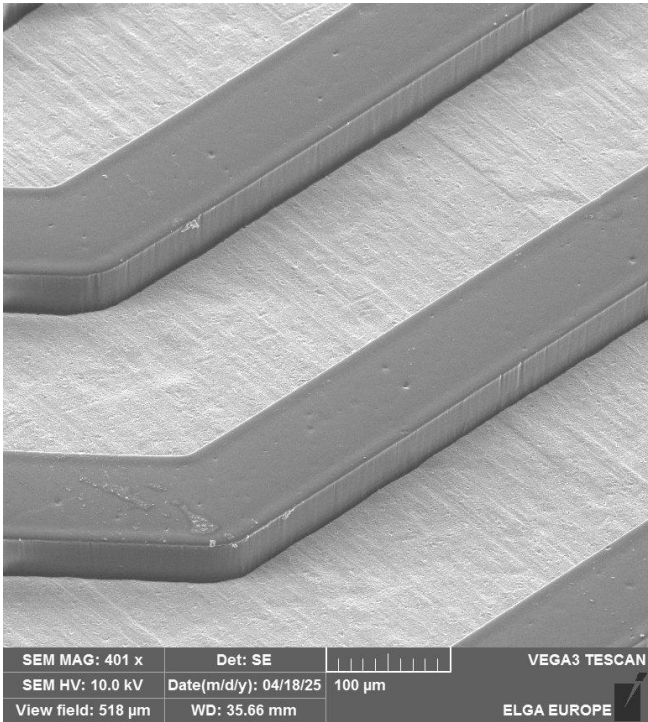


Optimizing Chemical
Milling

- 1. What is a Dry Film.
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- 8. About Elga Europe



ORDYL® AM 150

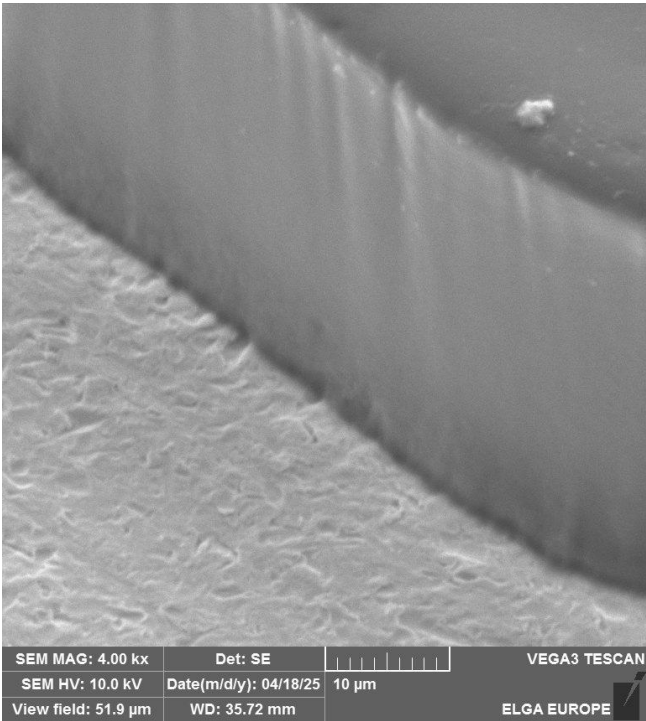
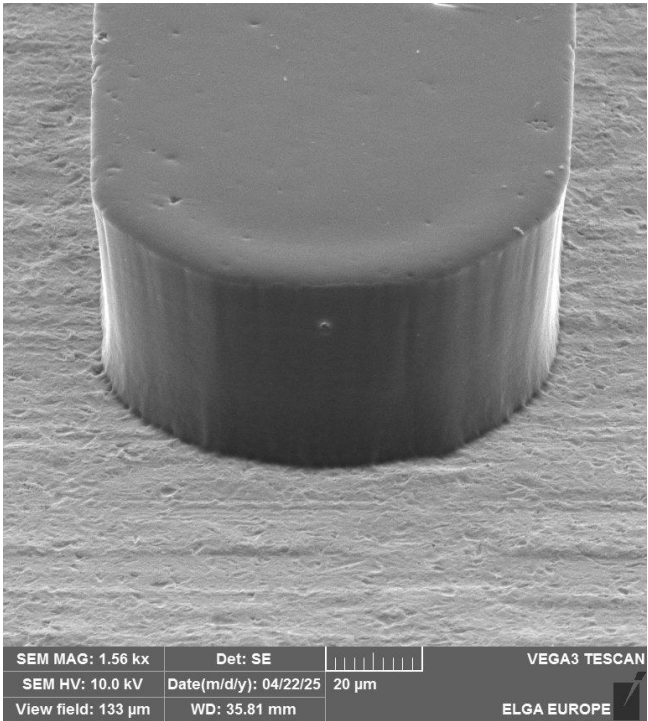
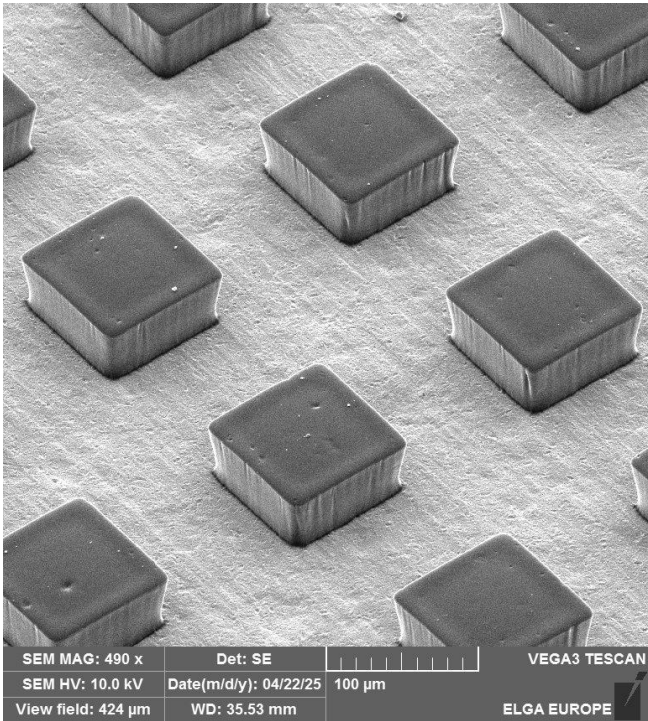


Optimizing Chemical
Milling

- 1. What is a Dry Film.
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- 8. About Elga Europe

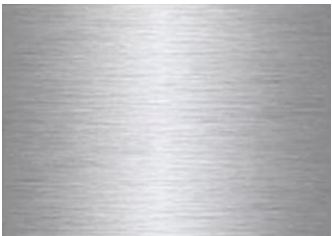


ORDYL® AM 150

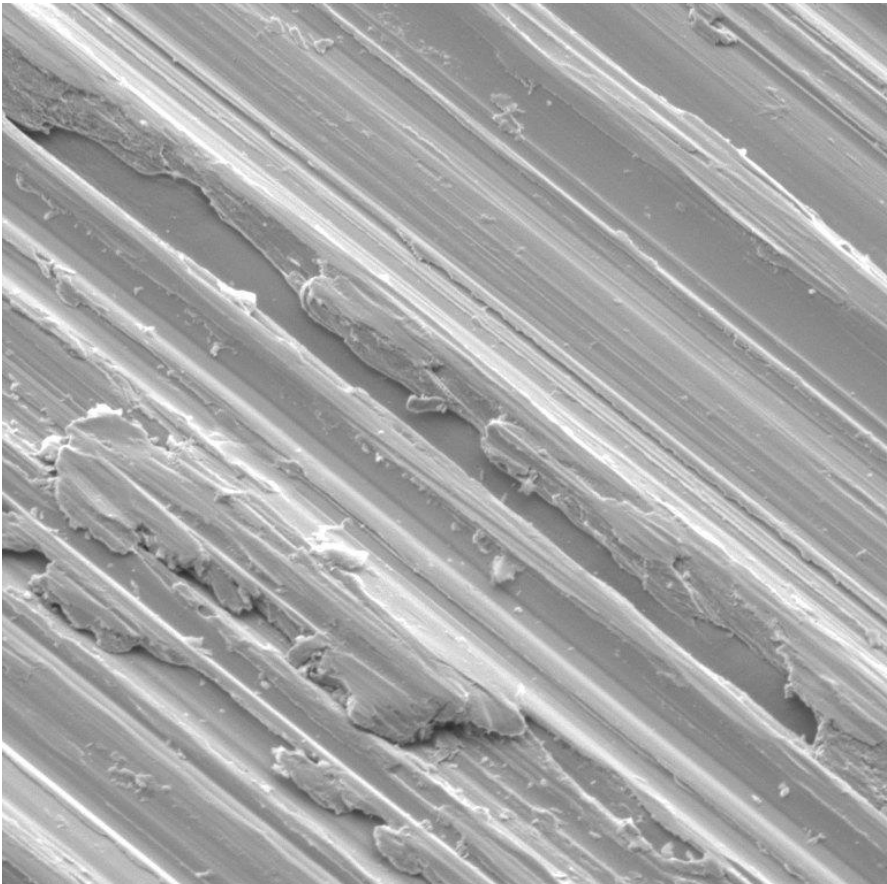


Optimizing Chemical
Milling

- 1. What is a Dry Film.
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- 8. About Elga Europe



STAINLESS STEEL SATIN



SEM MAG: 2.00 kx	Det: SE		VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	20 µm	
View field: 104 µm	WD: 35.37 mm		ELGA EUROPE



- ❑ Brushed surface, rough texture
- ❑ Decorative finish, strong and corrosion resistant



- ❑ **Lamination:** Adhesion, Conformability
- ❑ **Exposure:** Light scattering, blurry edges
- ❑ **Developing:** Residues
- ❑ **Etching:** Chemical resistance
- ❑ **Stripping:** Flakes and residues



- ❑ Different thicknesses
- ❑ Conformable

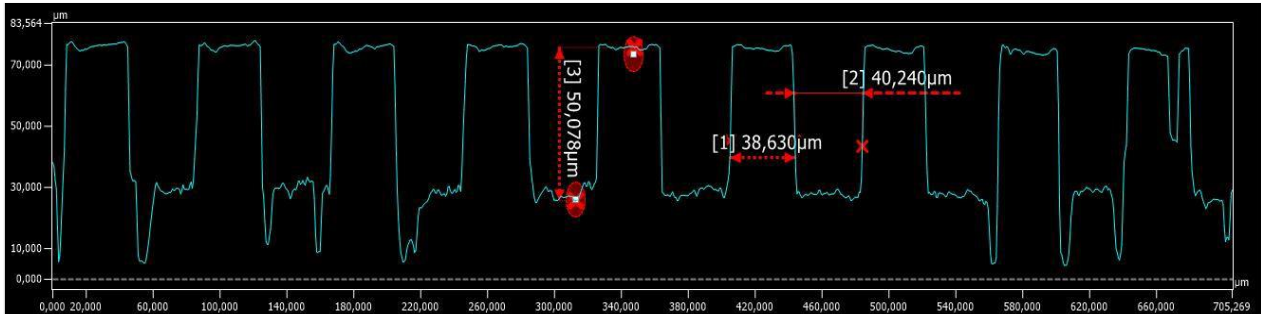
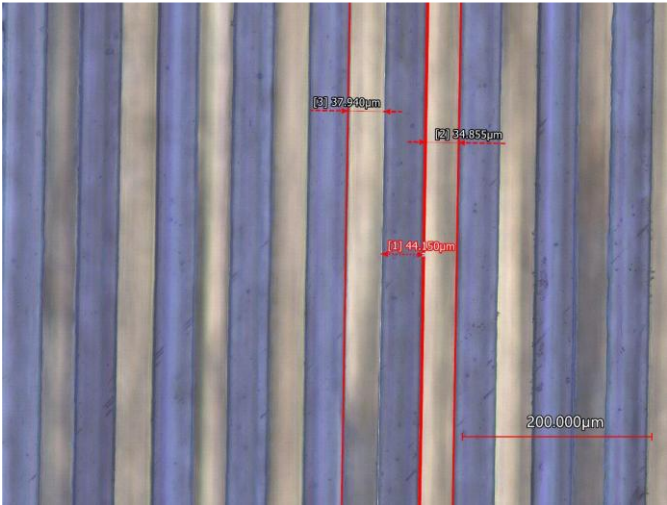
LAMINAR® E9200
LAMINAR® E9000

Optimizing Chemical
Milling

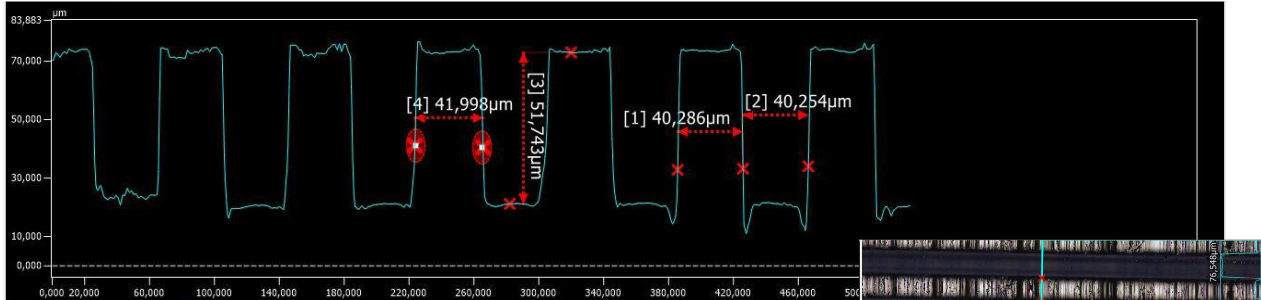
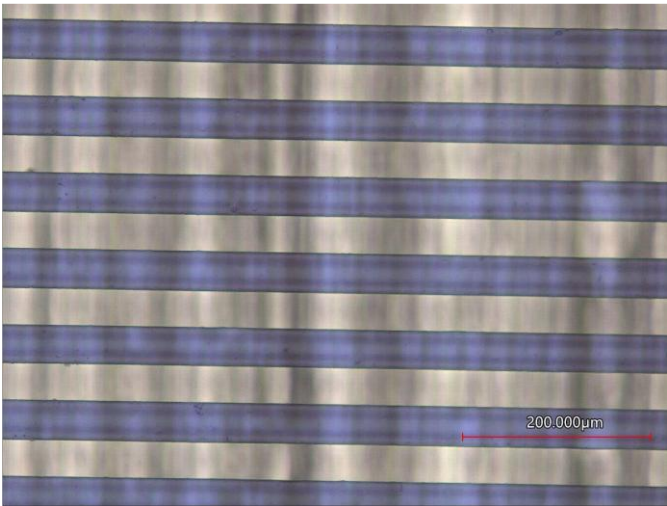
- 1. What is a Dry Film.
- 2. Different applications
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- 8. About Elga Europe



STAINLESS STEEL SATIN



Dry Film	E9220
L/S	40 µm
Energy	110 mJ/cm ²



Resolution against brush direction
is better than with the brush
direction – spaces much cleaner



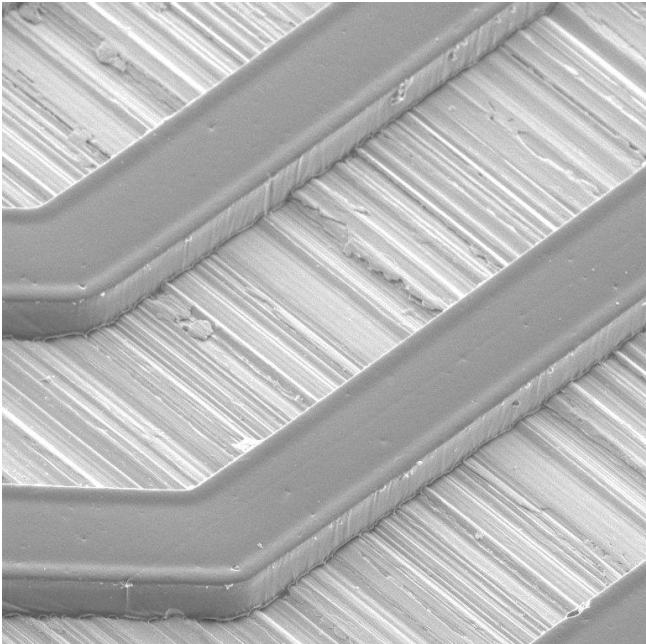
Optimizing Chemical
Milling

- 1. What is a Dry Film.
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- 8. About Elga Europe

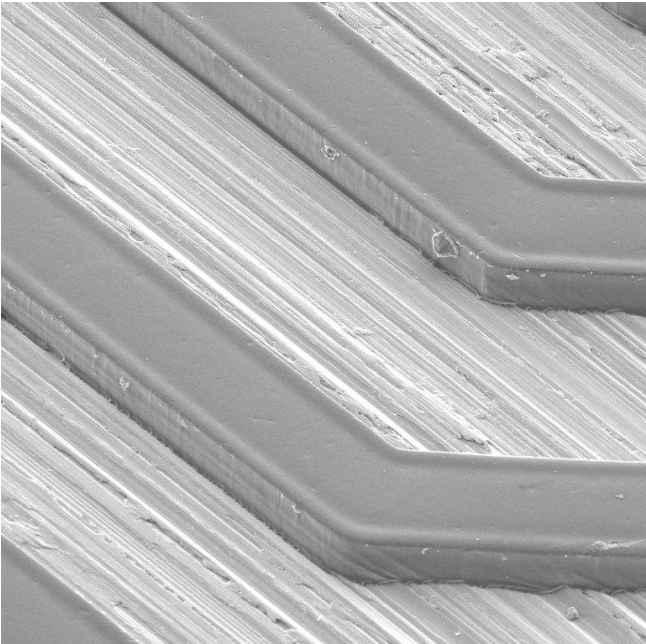


STAINLESS STEEL SATIN

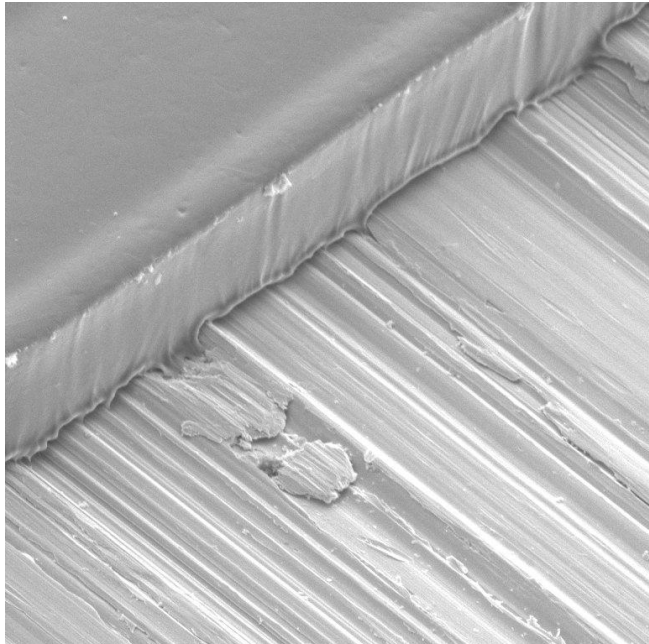
LAMINAR® E9220



SEM MAG: 400 x	Det: SE	100 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	100 µm	ELGA EUROPE
View field: 519 µm	WD: 34.81 mm		



SEM MAG: 399 x	Det: SE	100 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	100 µm	ELGA EUROPE
View field: 520 µm	WD: 35.09 mm		



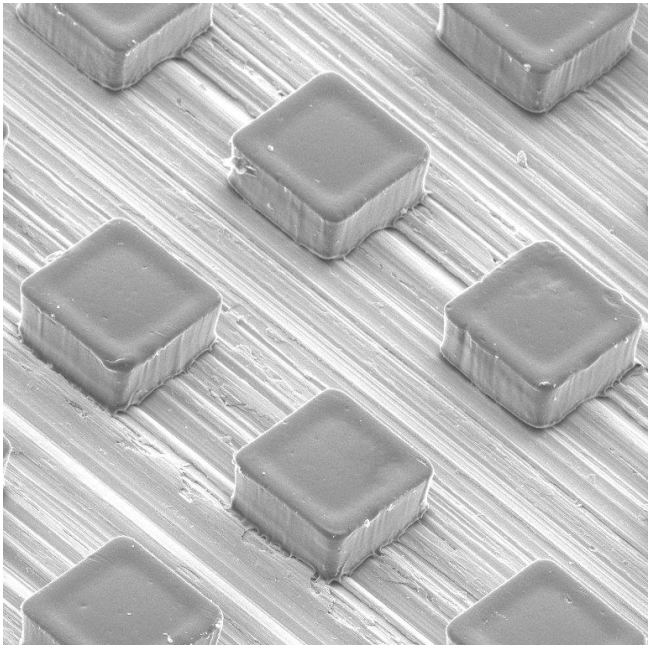
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SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	50 µm	ELGA EUROPE
View field: 167 µm	WD: 35.09 mm		

Optimizing Chemical
Milling

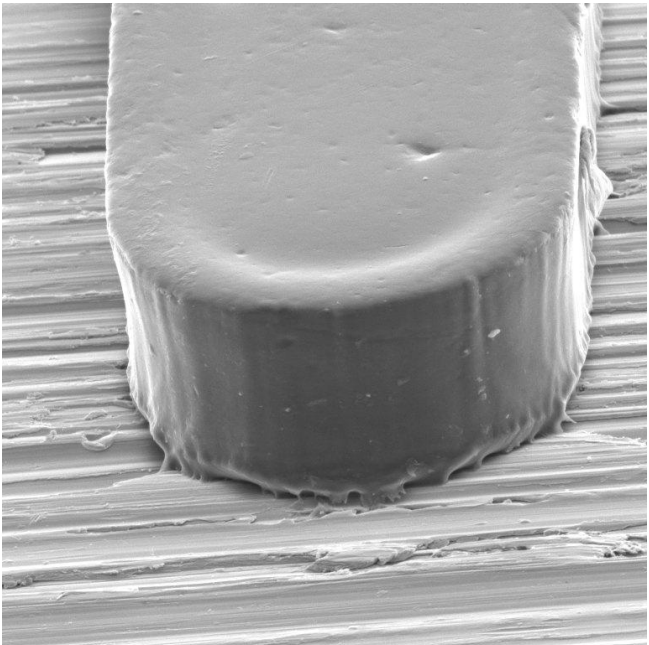
- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
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- 4. Dry Film production
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- 8. About Elga Europe



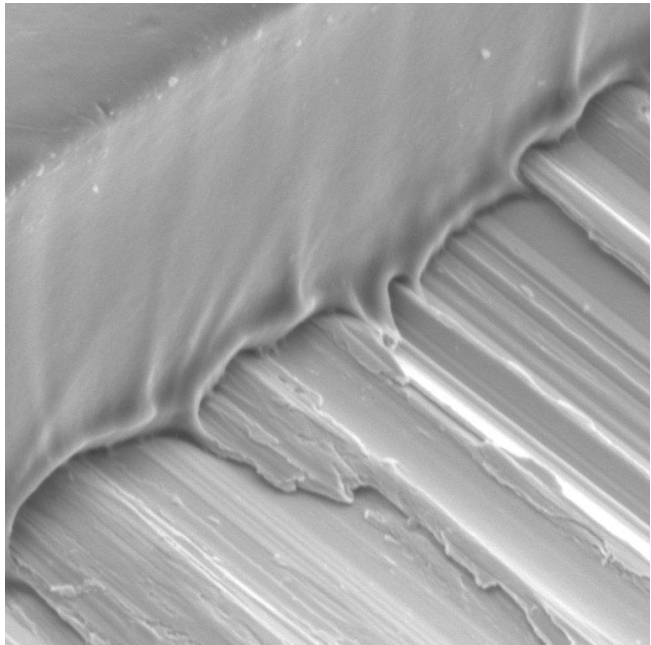
LAMINAR® E9220



SEM MAG: 490 x	Det: SE	100 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	WD: 34.41 mm	ELGA EUROPE
View field: 424 µm			



SEM MAG: 1.52 kx	Det: SE	20 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	WD: 35.06 mm	ELGA EUROPE
View field: 137 µm			



SEM MAG: 3.99 kx	Det: SE	10 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	WD: 35.02 mm	ELGA EUROPE
View field: 52.0 µm			

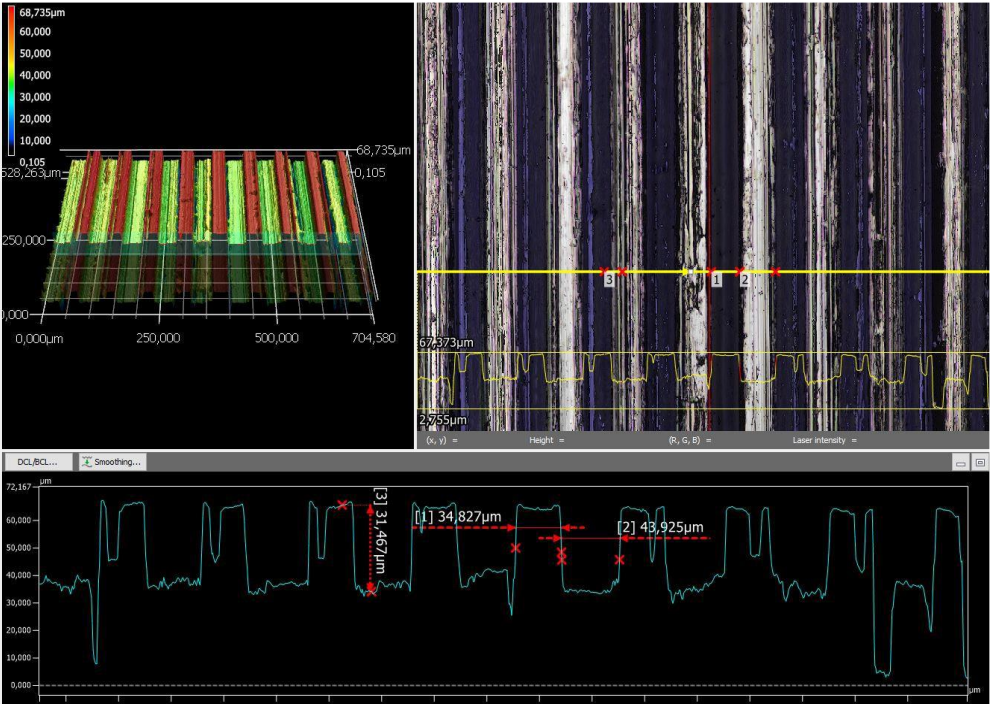
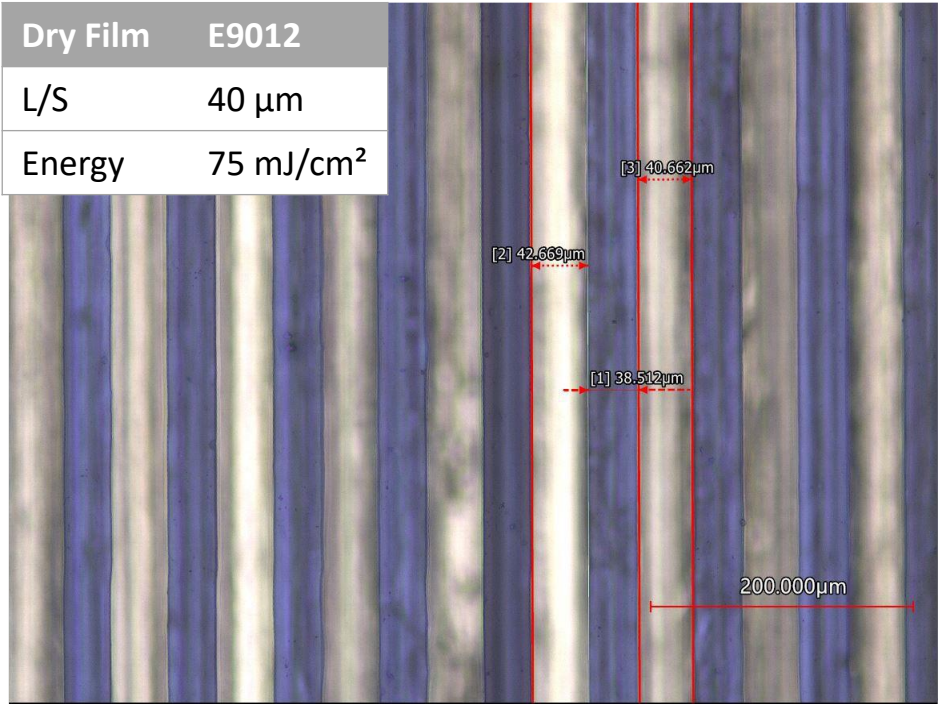


STAINLESS STEEL SATIN

Optimizing Chemical Milling

- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
- 3. Dry Film Composition
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- 8. About Elga Europe

Dry Film	E9012
L/S	40 µm
Energy	75 mJ/cm ²



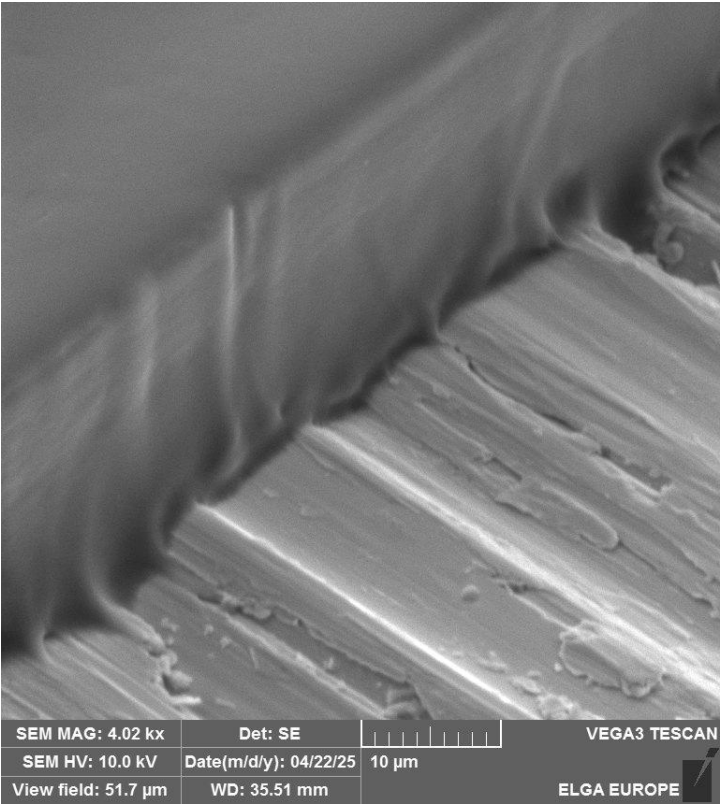
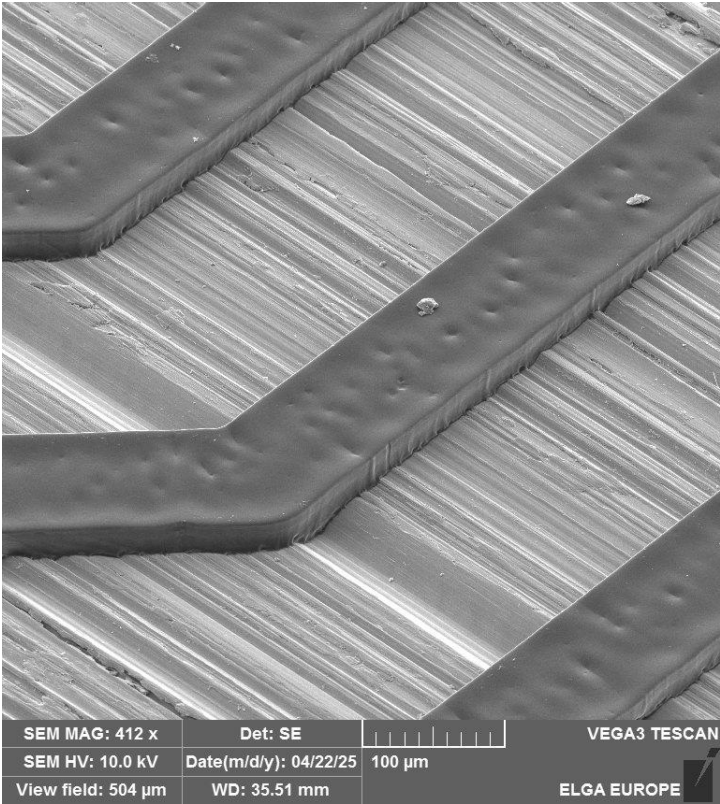
Optimizing Chemical
Milling

- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
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- 8. About Elga Europe



STAINLESS STEEL SATIN

LAMINAR® E9012

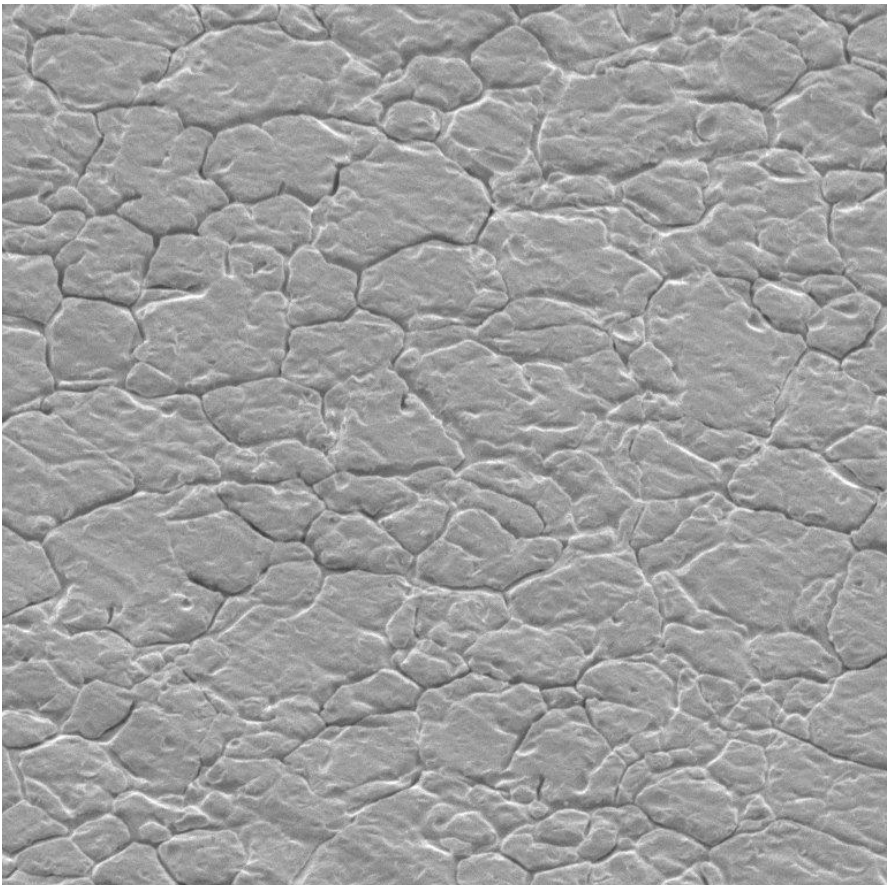


Optimizing Chemical
Milling

- 1. What is a Dry Film.
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 - Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
- 6. Processing conditions
- 7. Study on Different Materials
 - 7.1 Brass
 - 7.2 Stainless Steel Satin
 - 7.3 **Stainless Steel 2B**
 - 7.4 Stainless Steel BA Mirror
 - 7.5 Stainless Steel Supermirror (8K)
- 8. About Elga Europe



STAINLESS STEEL 2B



SEM MAG: 2.00 kx	Det: SE		VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/22/25	20 µm	
View field: 104 µm	WD: 35.51 mm		ELGA EUROPE



- ❑ Smooth matte surface low reflectivity
- ❑ general industry and technical parts



- ❑ **Lamination:** Surface cleanliness
- ❑ **Exposure:** Light bounce. Lower contrast
- ❑ **Developing:** Residues
- ❑ **Etching:** **Chemical Resistance**
- ❑ **Stripping:** Flakes and residues



- ❑ STD Dry Film (20 – 50 µm)
- ❑ Focus on Exposure

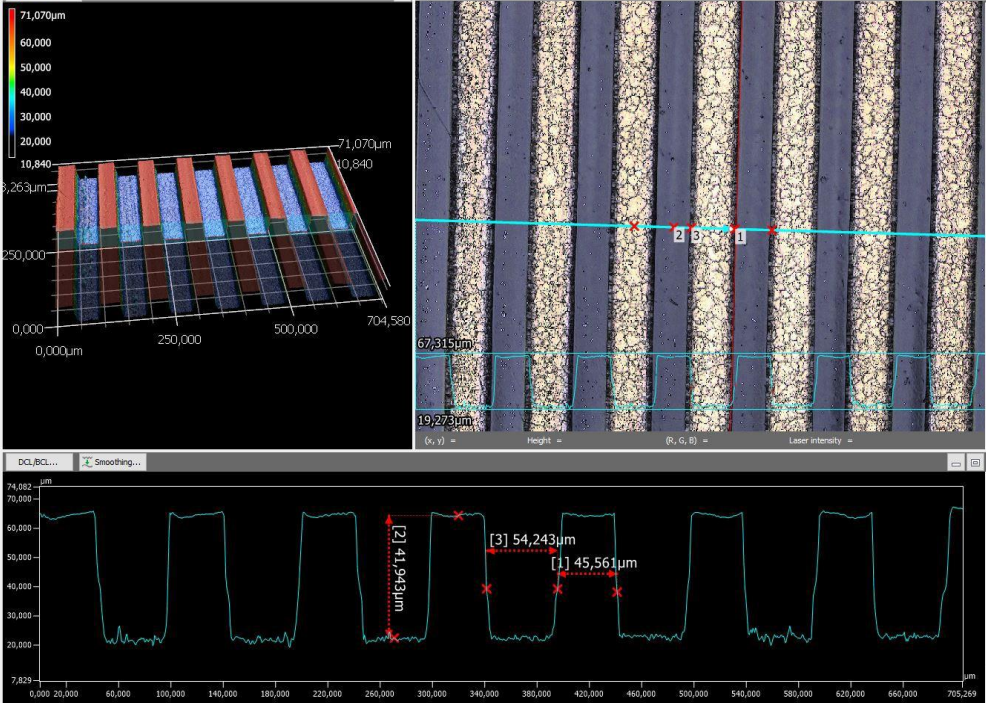
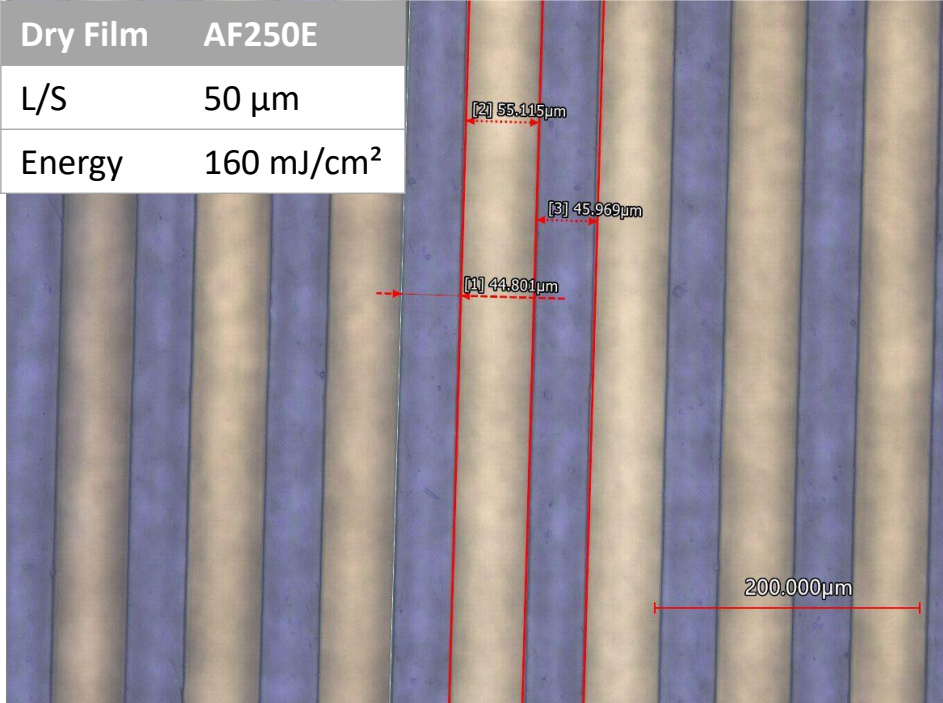
ORDYL® AF 200E



STAINLESS STEEL 2B

Optimizing Chemical Milling

- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
- 3. Dry Film Composition
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- 8. About Elga Europe



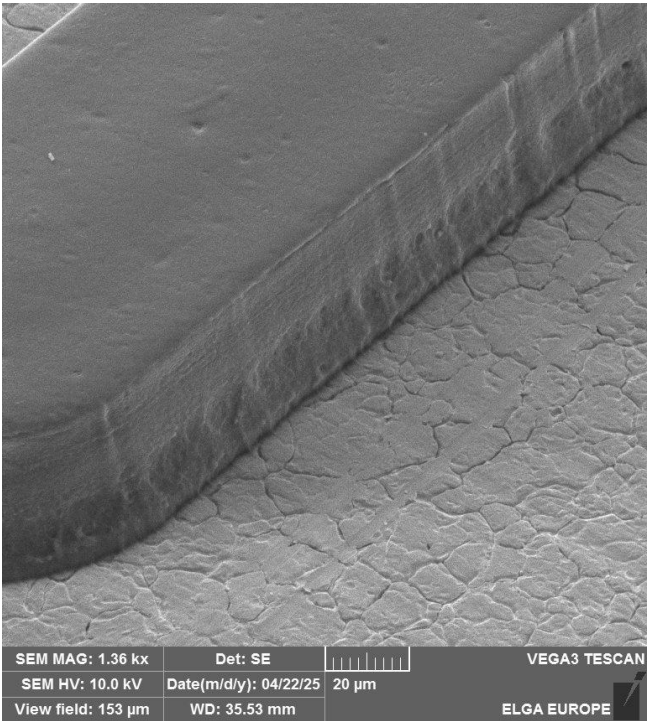
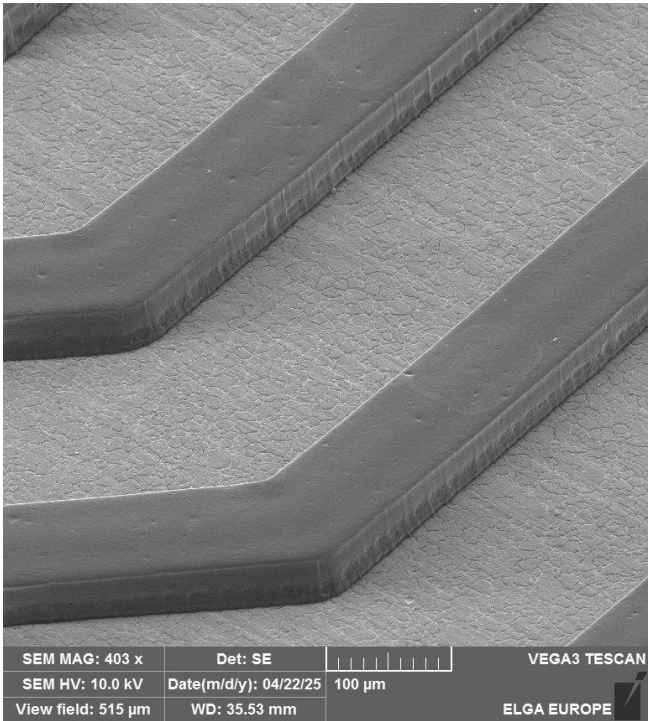
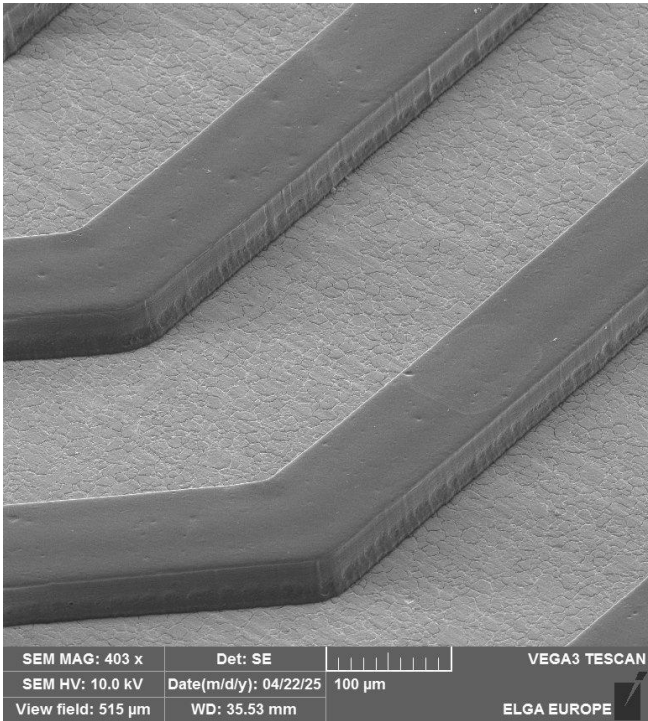
Optimizing Chemical
Milling

- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
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- 6. Processing conditions
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 - 7.4 Stainless Steel BA Mirror
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- 8. About Elga Europe



STAINLESS STEEL 2B

ORDYL® AF 250E

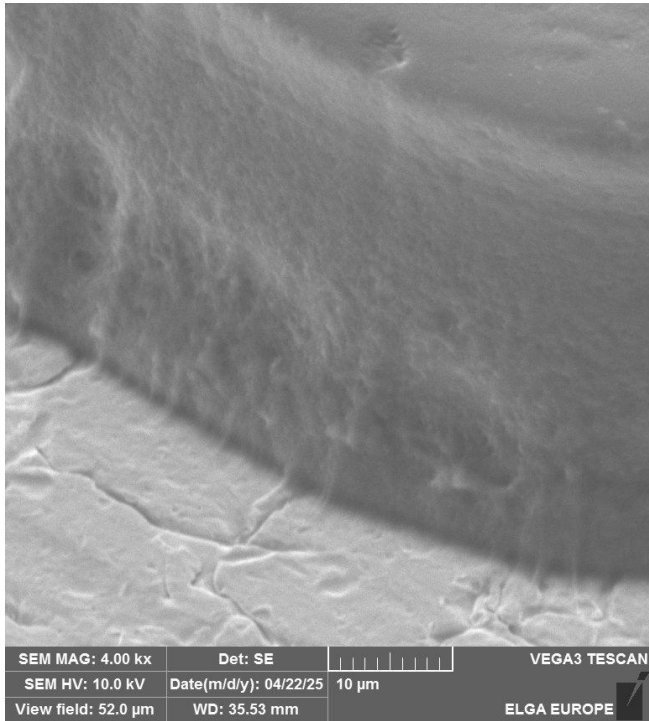
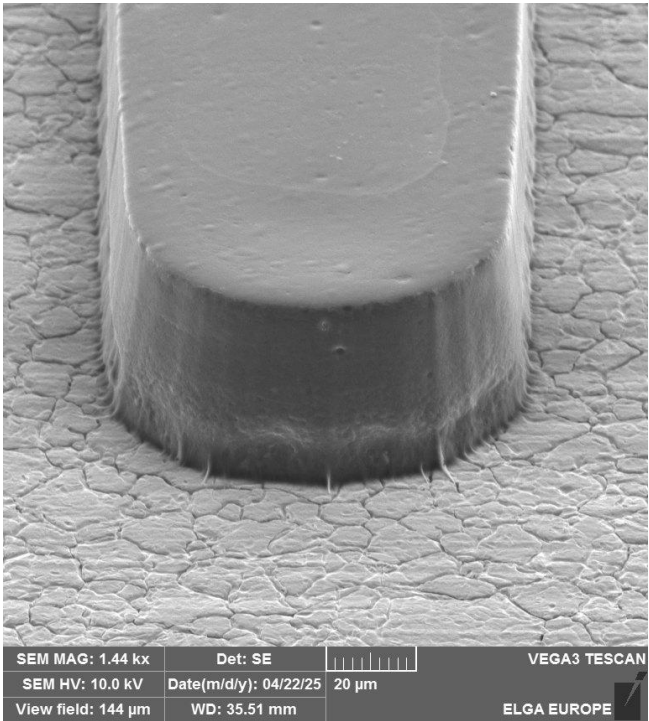
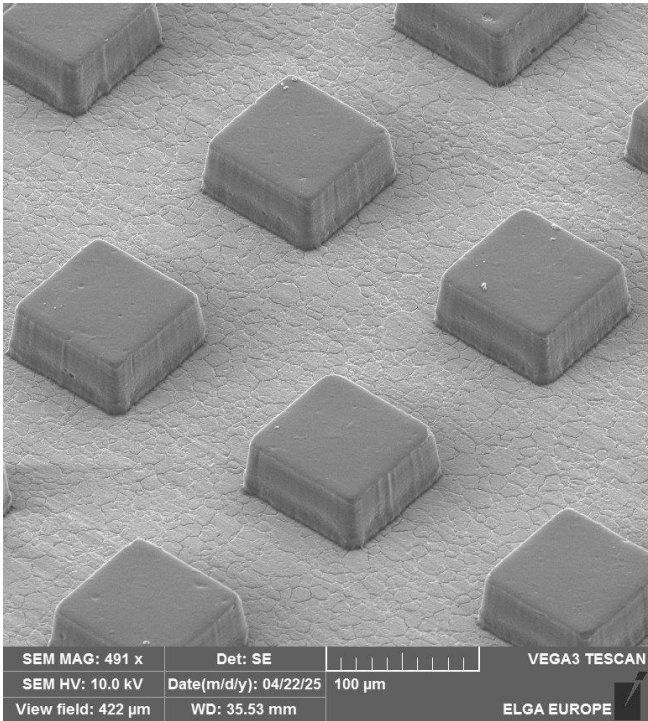


Optimizing Chemical
Milling

- 1. What is a Dry Film.
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 - 7.3 **Stainless Steel 2B**
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- 8. About Elga Europe

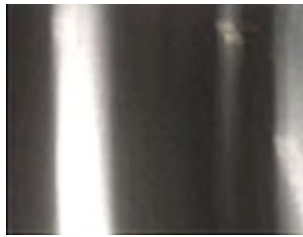


ORDYL® AF 250E

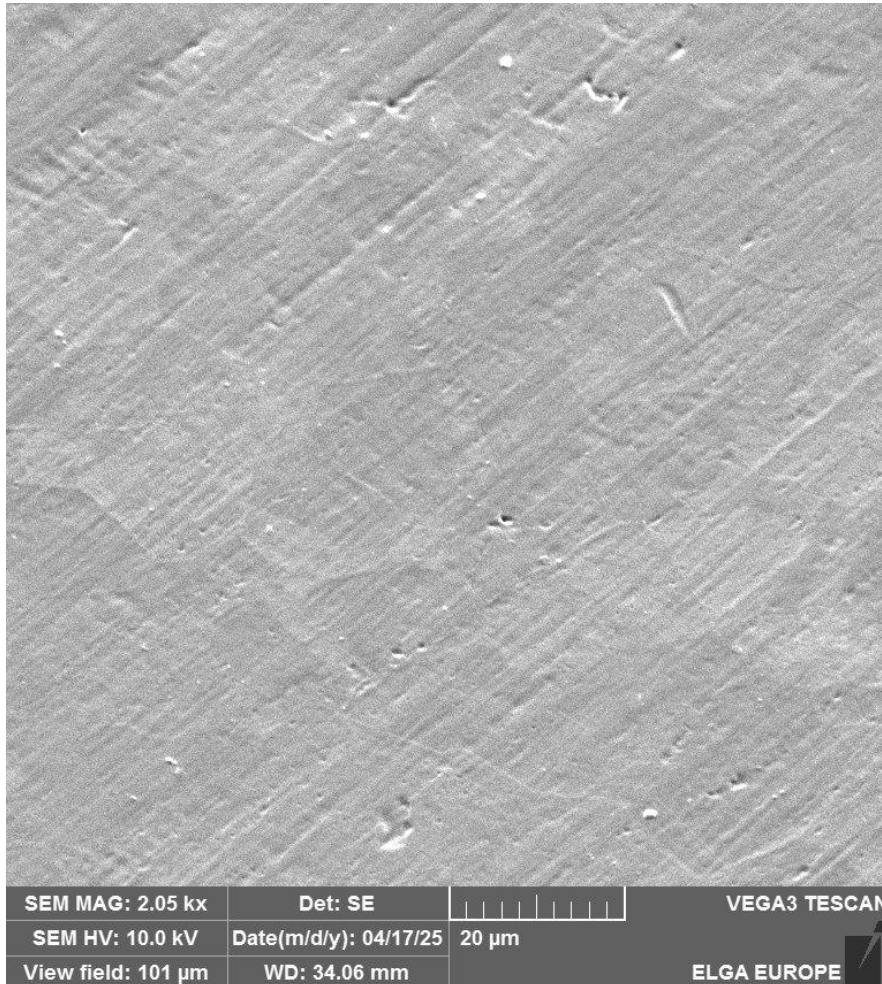


Optimizing Chemical Milling

1. What is a Dry Film.
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8. About Elga Europe



STAINLESS STEEL BA MIRROR



- ☐ Smooth and shiny semi-mirror finish
- ☐ Very low surface roughness



- ☐ **Lamination:** **adhesion**, slippery surface
- ☐ **Exposure:** **Reflections**. Ghost images
- ☐ **Developing:** Any DF defect is visible
- ☐ **Etching:** Pinholes
- ☐ **Stripping:** DF marks



- ☐ Optical grade DF (38–50 µm)
- ☐ Surface activator. Adh. promoter

LAMINAR® E9200

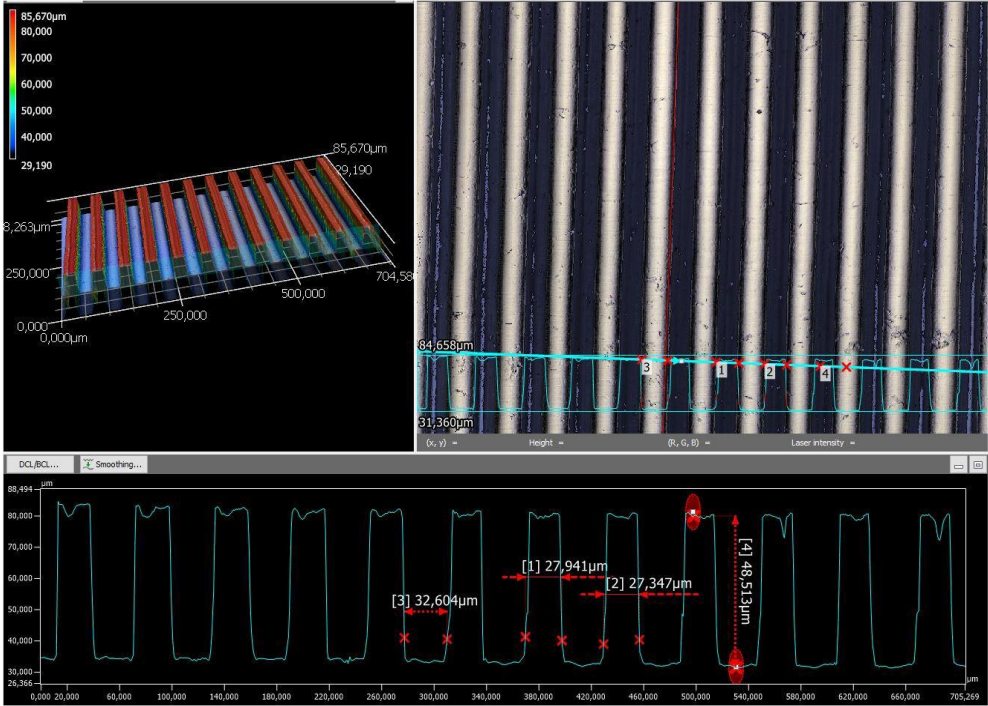
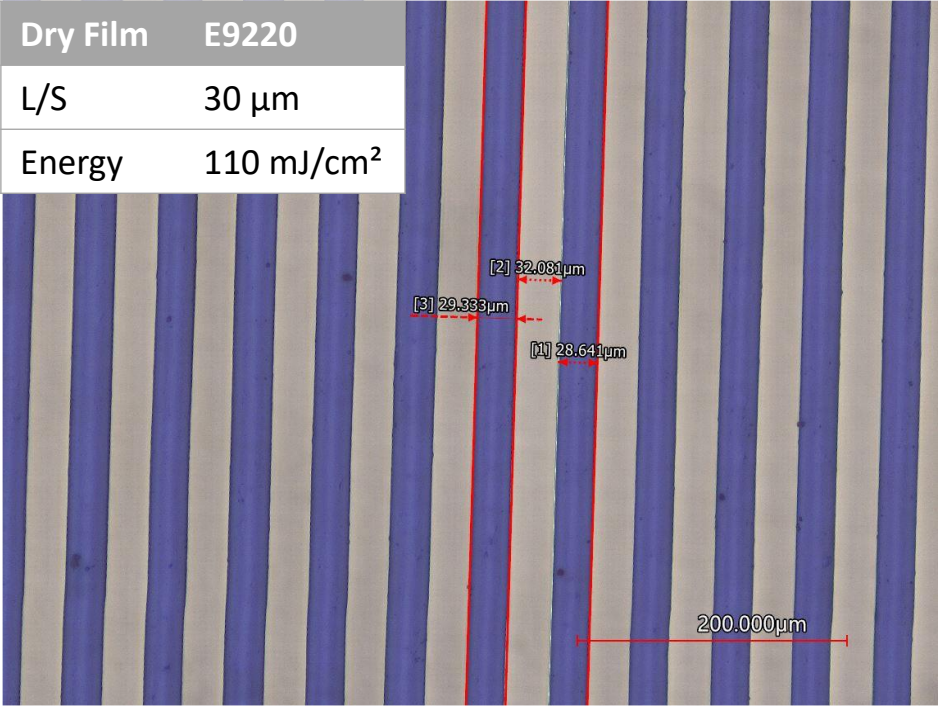


STAINLESS STEEL BA MIRROR

Optimizing Chemical Milling

- 1. What is a Dry Film.
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- 8. About Elga Europe

Dry Film	E9220
L/S	30 µm
Energy	110 mJ/cm²

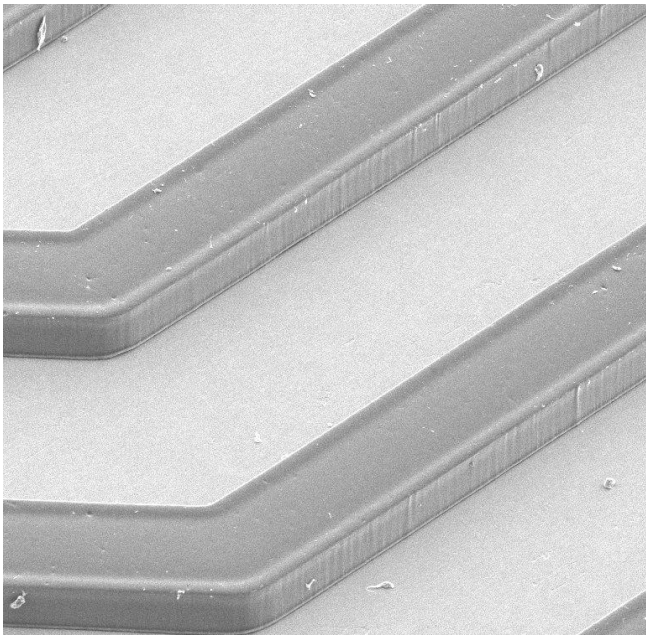


Optimizing Chemical
Milling

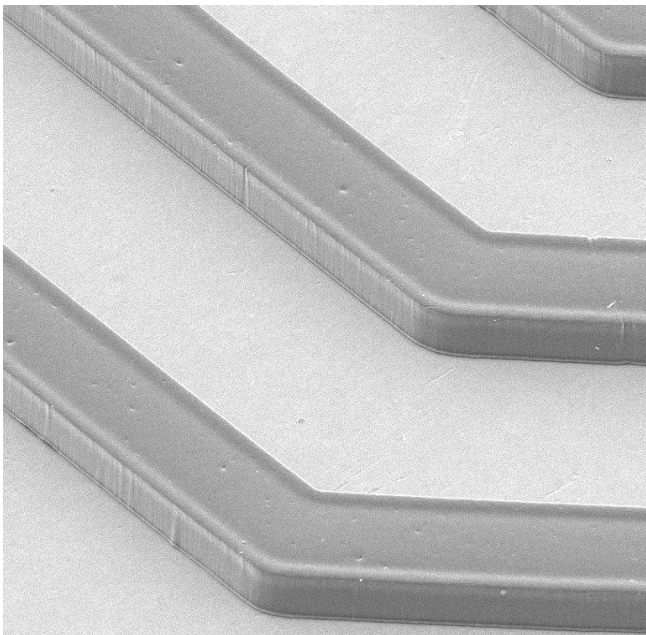
- 1. What is a Dry Film.
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- 8. About Elga Europe



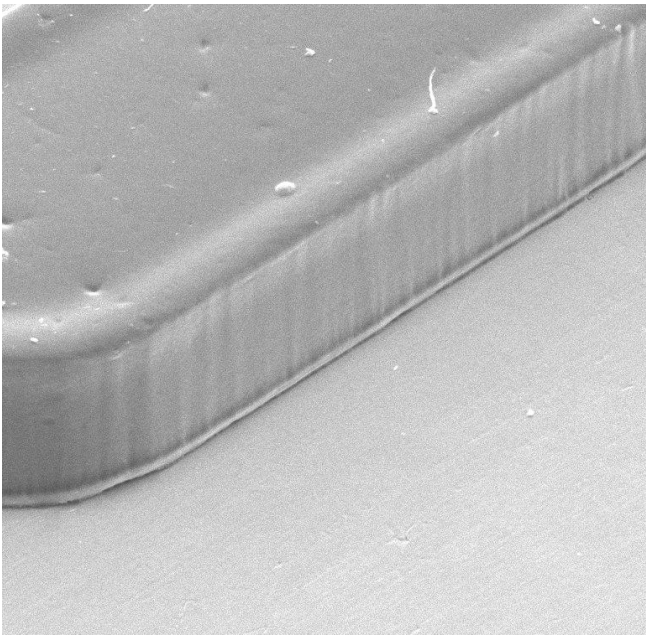
LAMINAR® E9220



SEM MAG: 401 x	Det: SE	100 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/16/25	100 µm	ELGA EUROPE
View field: 517 µm	WD: 34.00 mm		



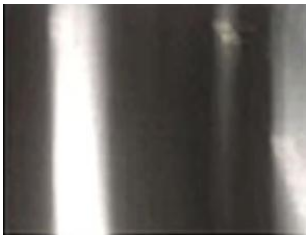
SEM MAG: 400 x	Det: SE	100 µm	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/16/25	100 µm	ELGA EUROPE
View field: 519 µm	WD: 34.00 mm		



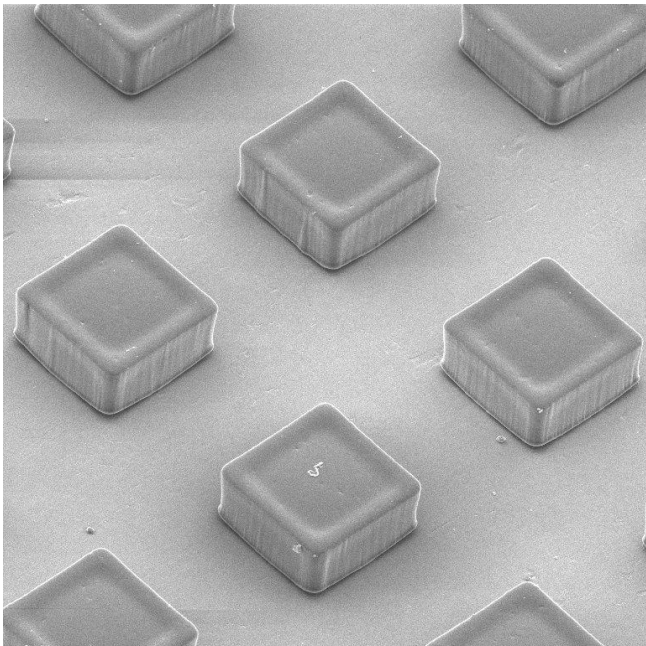
SEM MAG: 1.40 kx	Det: SE	20 µm	VEGA3 TESCAN
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View field: 148 µm	WD: 34.00 mm		

Optimizing Chemical
Milling

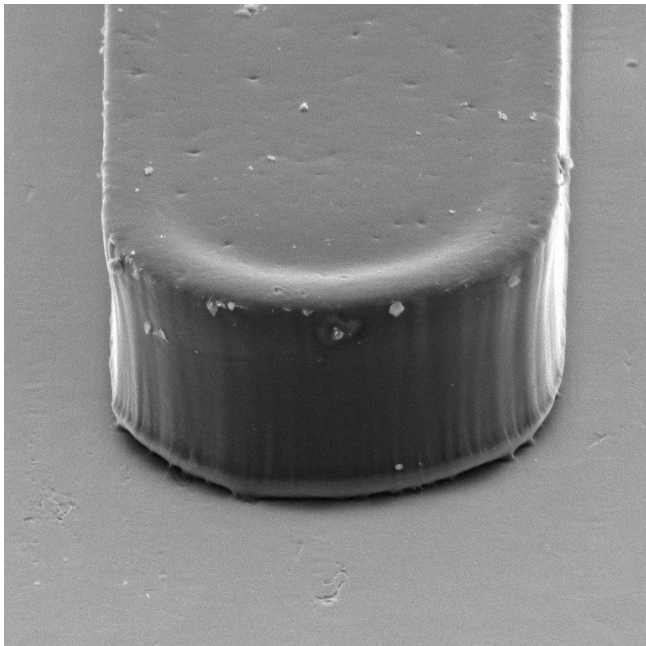
- 1. What is a Dry Film.
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- 8. About Elga Europe



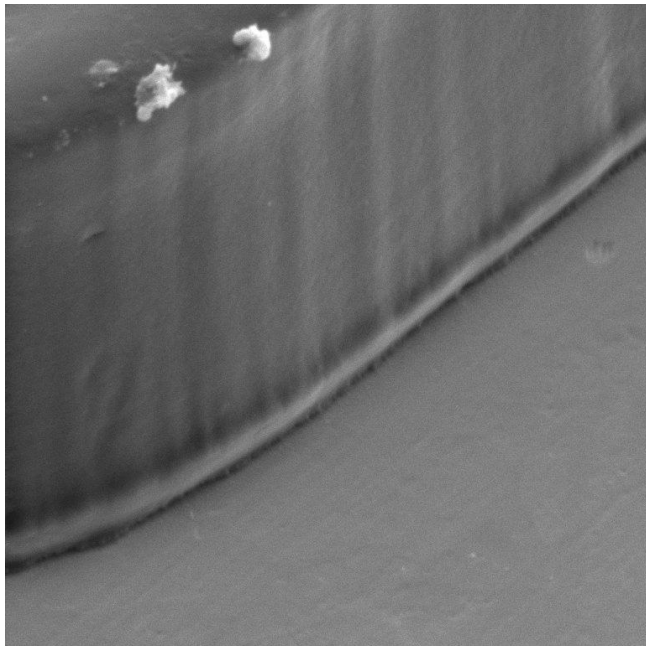
LAMINAR® E9220



SEM MAG: 491 x	Det: SE	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/16/25	100 µm
View field: 423 µm	WD: 34.00 mm	ELGA EUROPE



SEM MAG: 1.50 kx	Det: SE	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/16/25	20 µm
View field: 138 µm	WD: 34.00 mm	ELGA EUROPE



SEM MAG: 4.05 kx	Det: SE	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/17/25	10 µm
View field: 51.3 µm	WD: 34.06 mm	ELGA EUROPE

Optimizing Chemical
Milling

- 1. What is a Dry Film.
- 2. Different applications
Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
- 6. Processing conditions

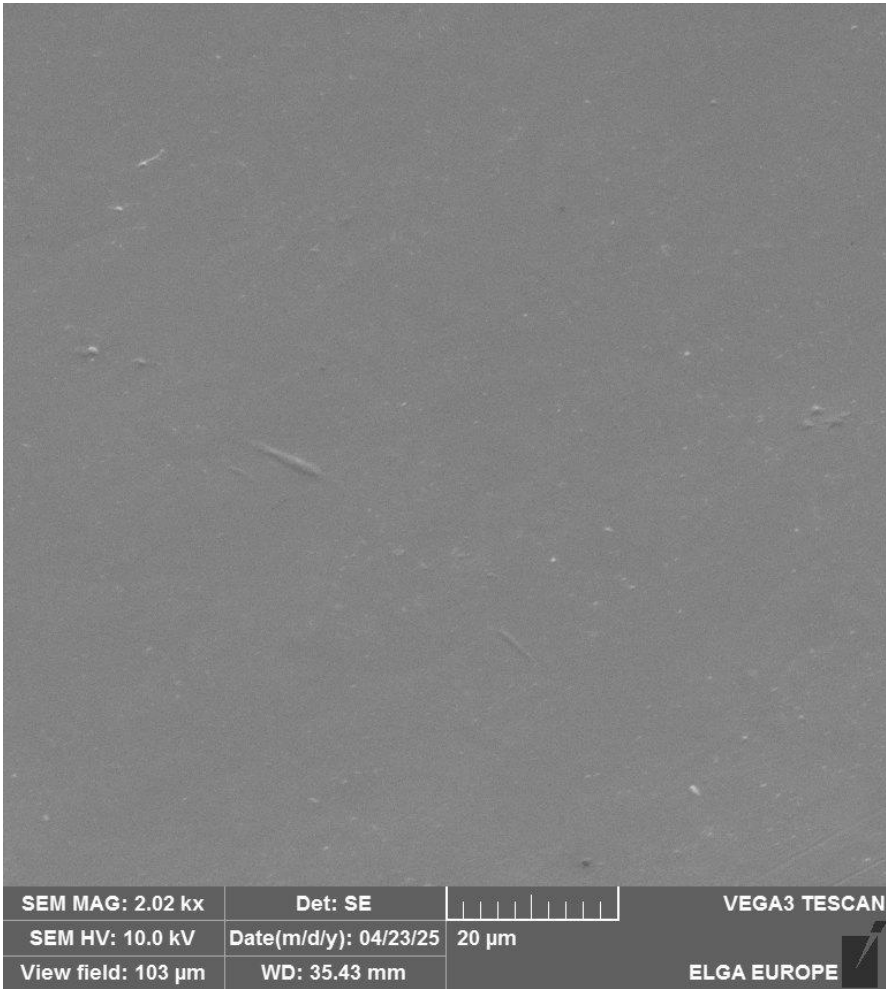
7. Study on Different Materials

- 7.1 Brass
- 7.2 Stainless Steel Satin
- 7.3 Stainless Steel 2B
- 7.4 Stainless Steel BA Mirror
- 7.5 **Stainless Steel Supermirror (8K)**

- 8. About Elga Europe



STAINLESS STEEL Supermirror 8K



- ☐ Perfect mirror finish highly reflective
- ☐ Used in art, luxury and design



- ☐ **Lamination:** **adhesion**, slippery surface
- ☐ **Exposure:** **Reflections**. Image defects
- ☐ **Developing:** Overdeveloping. Edge lift
- ☐ **Etching:** Errors become visible
- ☐ **Stripping:** damage non-etch areas



- ☐ Wet Lamination
- ☐ Surface activator. Adh. promoter

ORDYL® AM 100DI



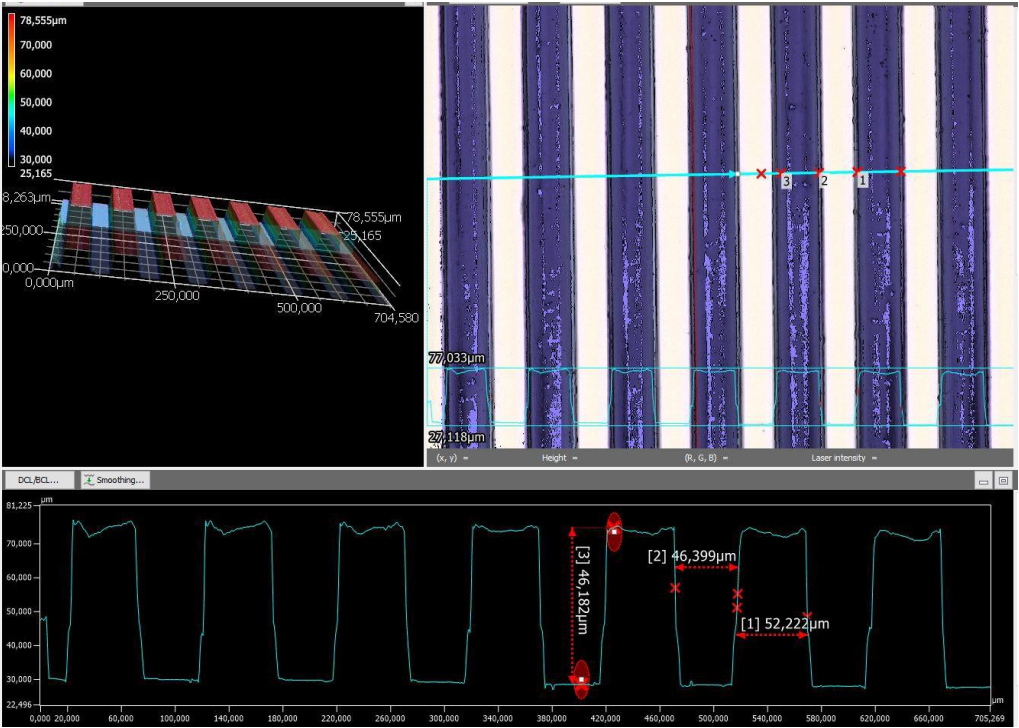
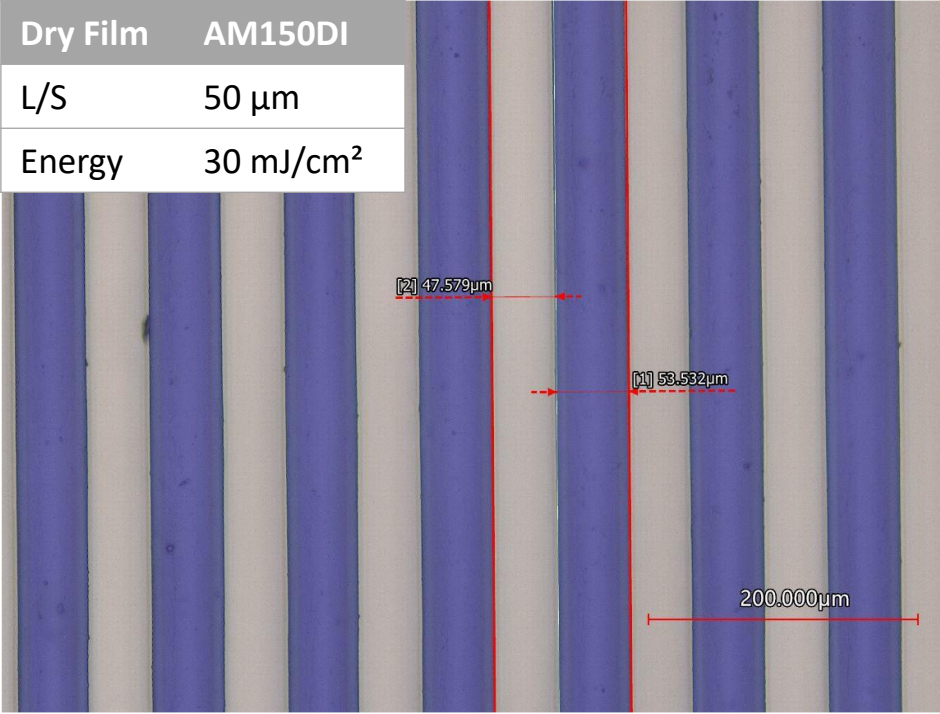
Optimizing Chemical Milling

- 1. What is a Dry Film.
- 2. Different applications
 - Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
- 6. Processing conditions

7. Study on Different Materials

- 7.1 Brass
- 7.2 Stainless Steel Satin
- 7.3 Stainless Steel 2B
- 7.4 Stainless Steel BA Mirror
- 7.5 **Stainless Steel Supermirror (8K)**

- 8. About Elga Europe



Optimizing Chemical
Milling

- 1. What is a Dry Film.
- 2. Different applications
 Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
- 6. Processing conditions

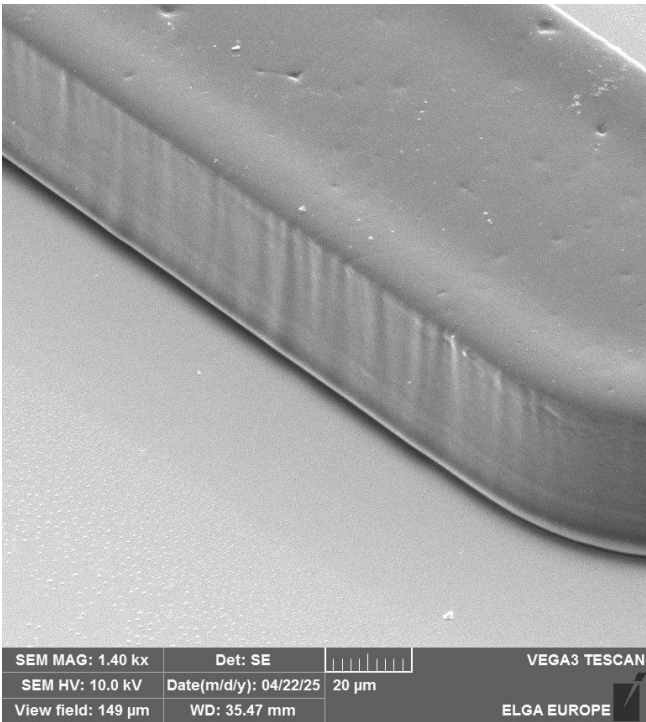
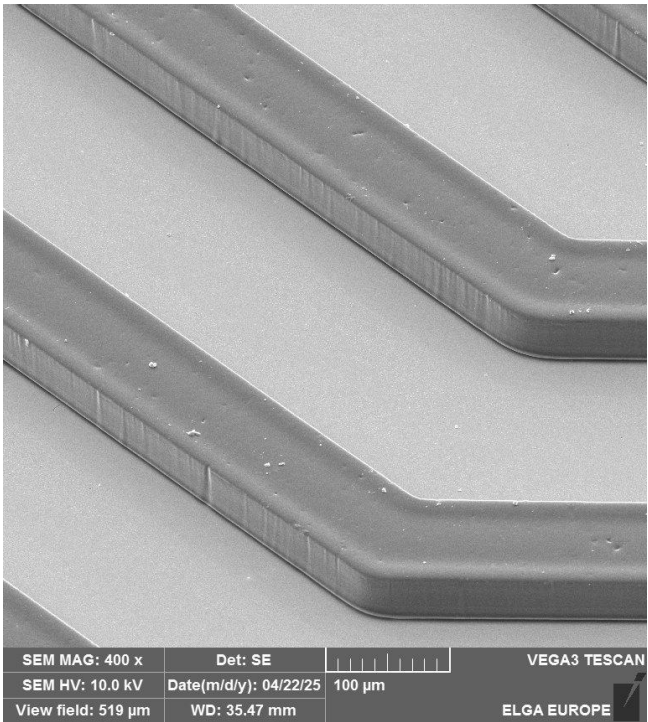
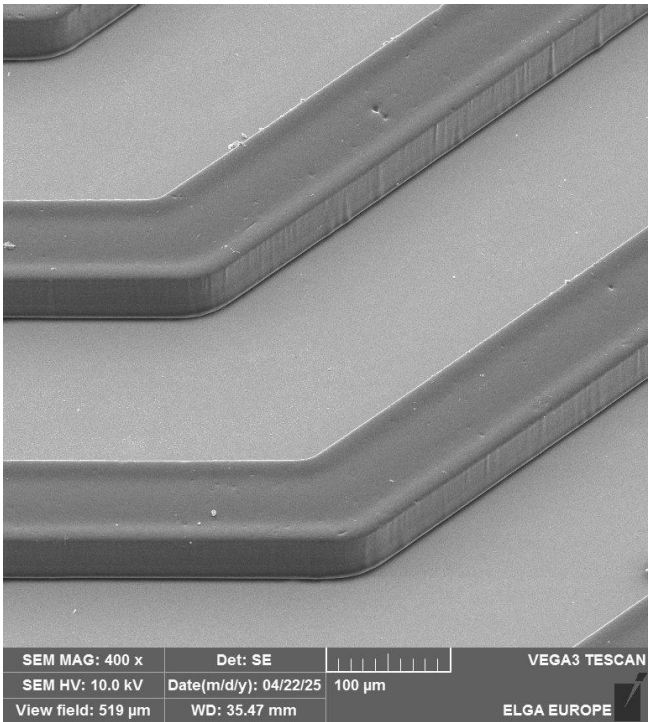
7. Study on Different Materials

- 7.1 Brass
- 7.2 Stainless Steel Satin
- 7.3 Stainless Steel 2B
- 7.4 Stainless Steel BA Mirror
- 7.5 **Stainless Steel Supermirror (8K)**

- 8. About Elga Europe



ORDYL® AM 150DI



Optimizing Chemical
Milling

- 1. What is a Dry Film.
- 2. Different applications
 Different Dry Films
- 3. Dry Film Composition
- 4. Dry Film production
- 5. Key Features of Dry Film
- 6. Processing conditions

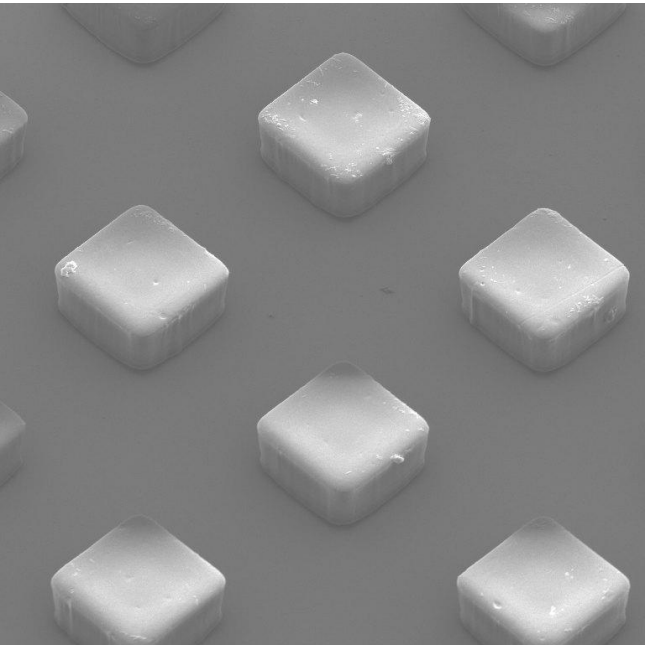
7. Study on Different Materials

- 7.1 Brass
- 7.2 Stainless Steel Satin
- 7.3 Stainless Steel 2B
- 7.4 Stainless Steel BA Mirror
- 7.5 **Stainless Steel Supermirror (8K)**

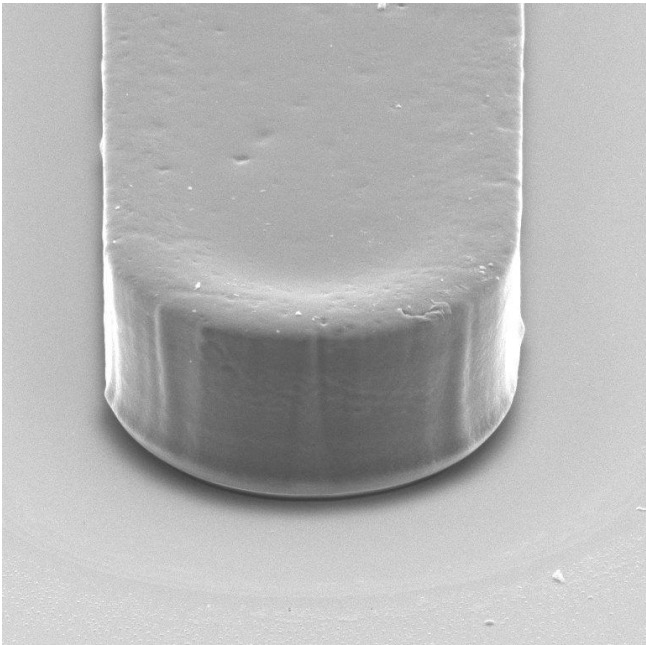
- 8. About Elga Europe



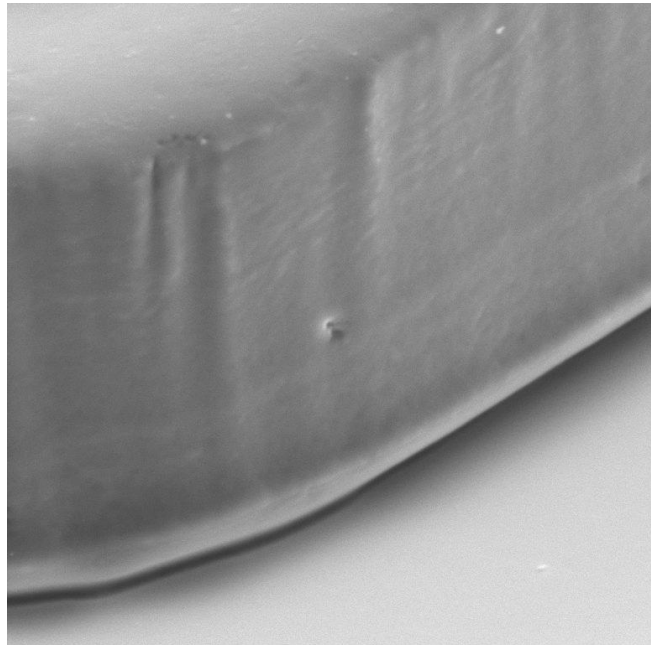
ORDYL® AM 150DI



SEM MAG: 462 x	Det: SE	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/23/25	100 µm
View field: 450 µm	WD: 35.48 mm	ELGA EUROPE



SEM MAG: 1.41 kx	Det: SE	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/22/25	20 µm
View field: 147 µm	WD: 35.47 mm	ELGA EUROPE



SEM MAG: 4.01 kx	Det: SE	VEGA3 TESCAN
SEM HV: 10.0 kV	Date(m/d/y): 04/22/25	10 µm
View field: 51.7 µm	WD: 35.47 mm	ELGA EUROPE

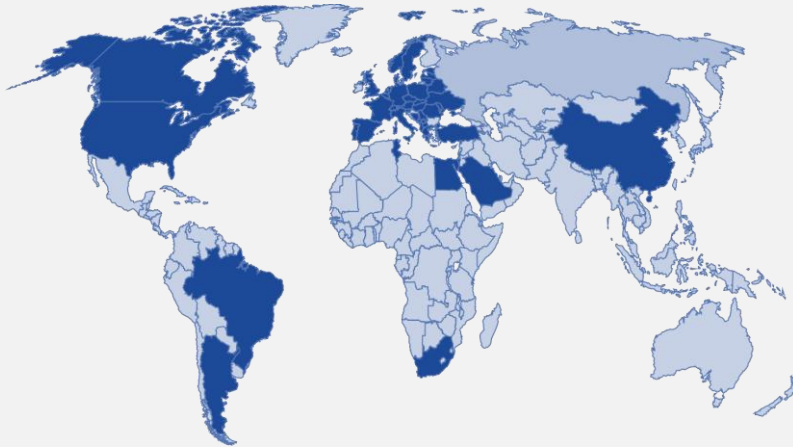
8. About Elga Europe

**European Leader in
Dry Film Photoresist**

**The only Dry Film
producer in Europe**

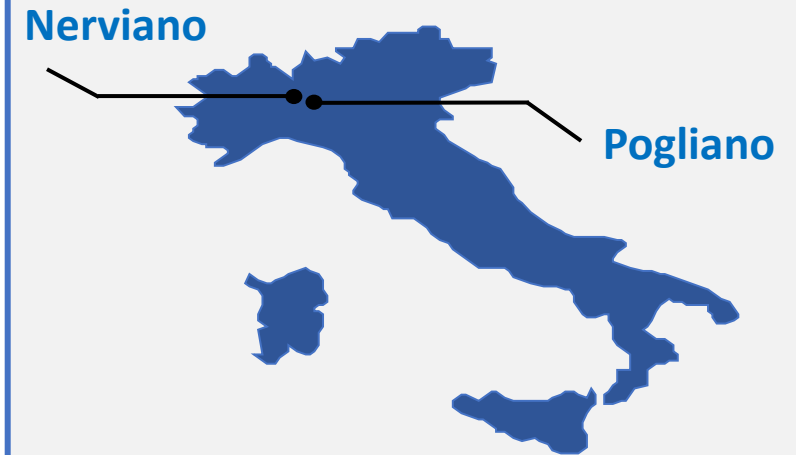
**Raw material
sourcing in Europe**

Global presence



About
ElgaEurope
Living inside technology

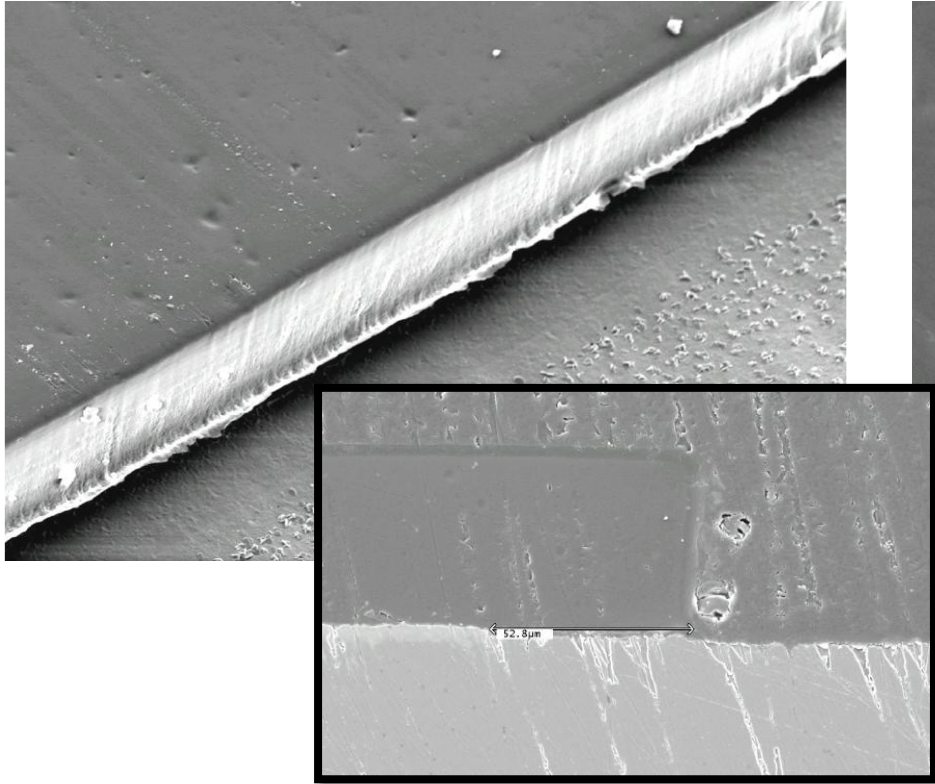
2 Production sites in EU



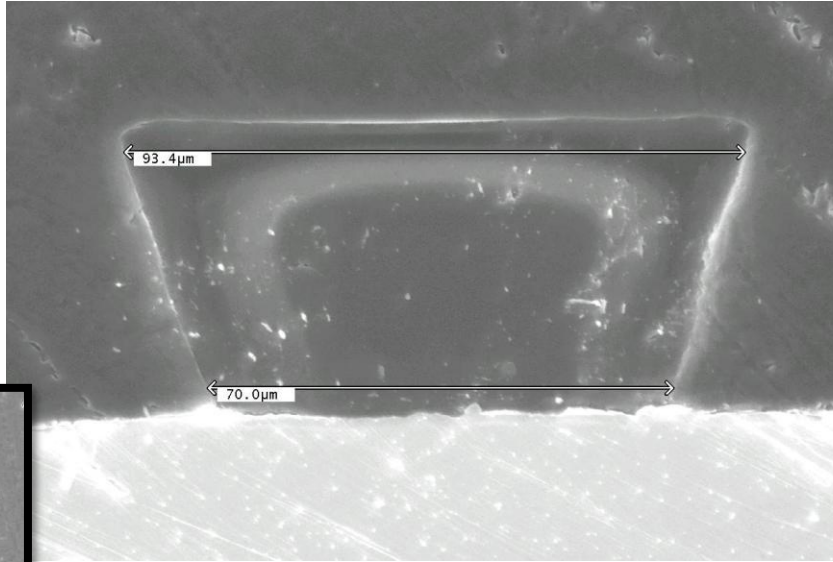
**Production capacity: + 15 million SQM/Year
70 employees**

TECHNICAL SERVICE

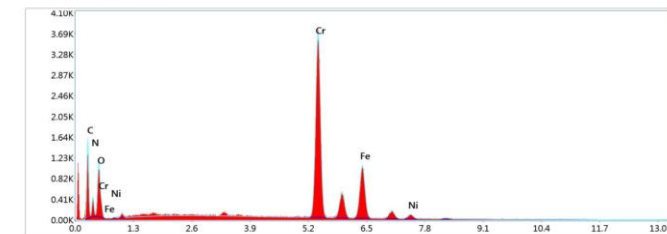
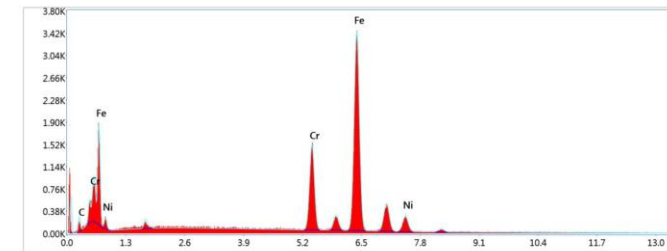
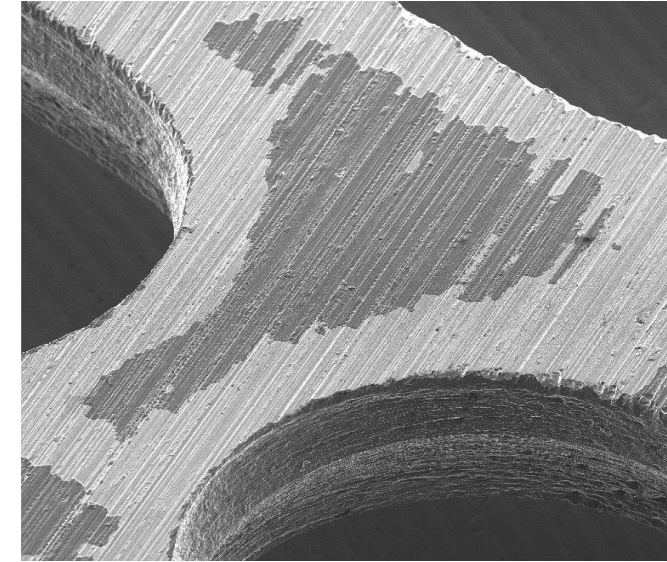
Adhesion issues in lamination



Definition due to exposition settings



Contamination after etching



50+ years of experience.

Equipped with SEM, XRF, AA, CVS...

Ready to solve your toughest challenges.

ElgaEurope

Living inside technology

Thank you



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