PHOTORESIST MANUFACTURING & INNOVATION

H.A.R.E SQ Negative Tone Photoresist

High Aspect Ratio Epoxy | Superior Quality

HARE SQ™ Negative Epoxy

For MEMS and Microfluidics Applications

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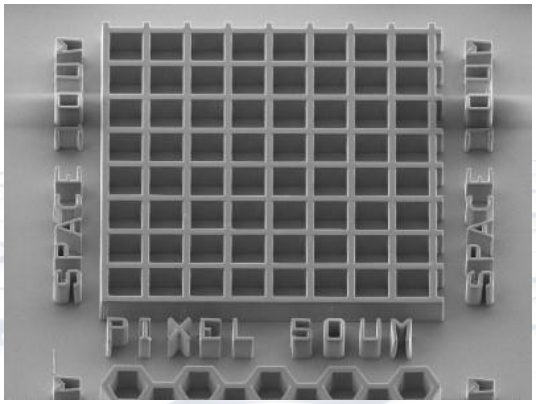
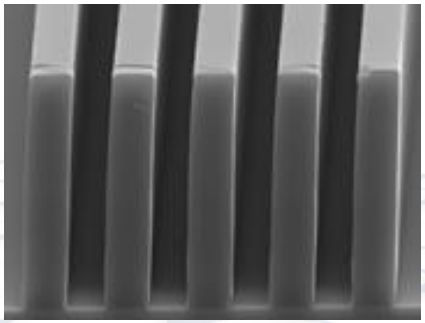
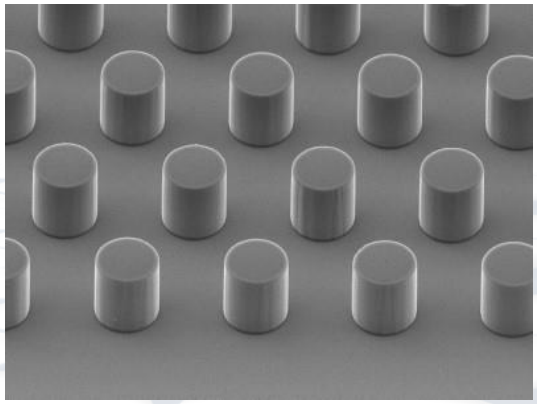
HARE SQ™ is a negative epoxy photoresist designed for polymeric MEMS, microfluidics, micromachining, and other microelectronic applications. This resist has excellent chemical, mechanical and thermal resistance, making it suitable for permanent applications. HARE SQ™ is sensitive to NUV, i-line and broadband wavelengths.

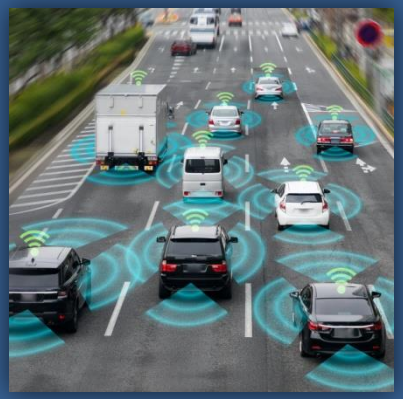
Tone:	Negative
FT:	2 – 100+ µm
Sensitivity:	NUV, broadband, i-line
Substrates:	Adheres to a variety of substrates; including gold, glass, aluminum, chromium and copper.
Develop:	Designed for use with HARE SQ™ developer. It can be developed using immersion, puddle or spray puddle.



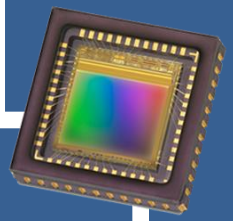


5 µm dense line/space in 25 µm film

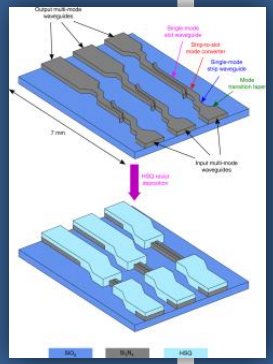


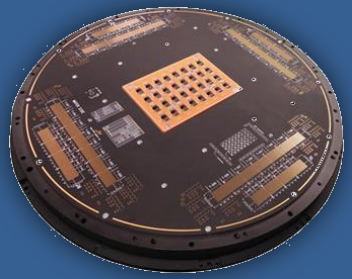


Sensors

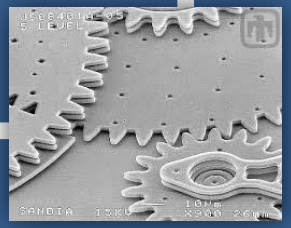


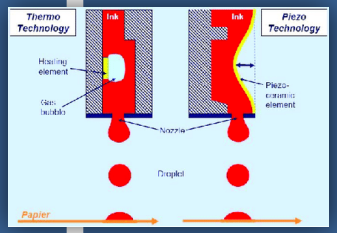
Waveguides





MEMS





Microfluidics
Inkjet

Antennas

Applications

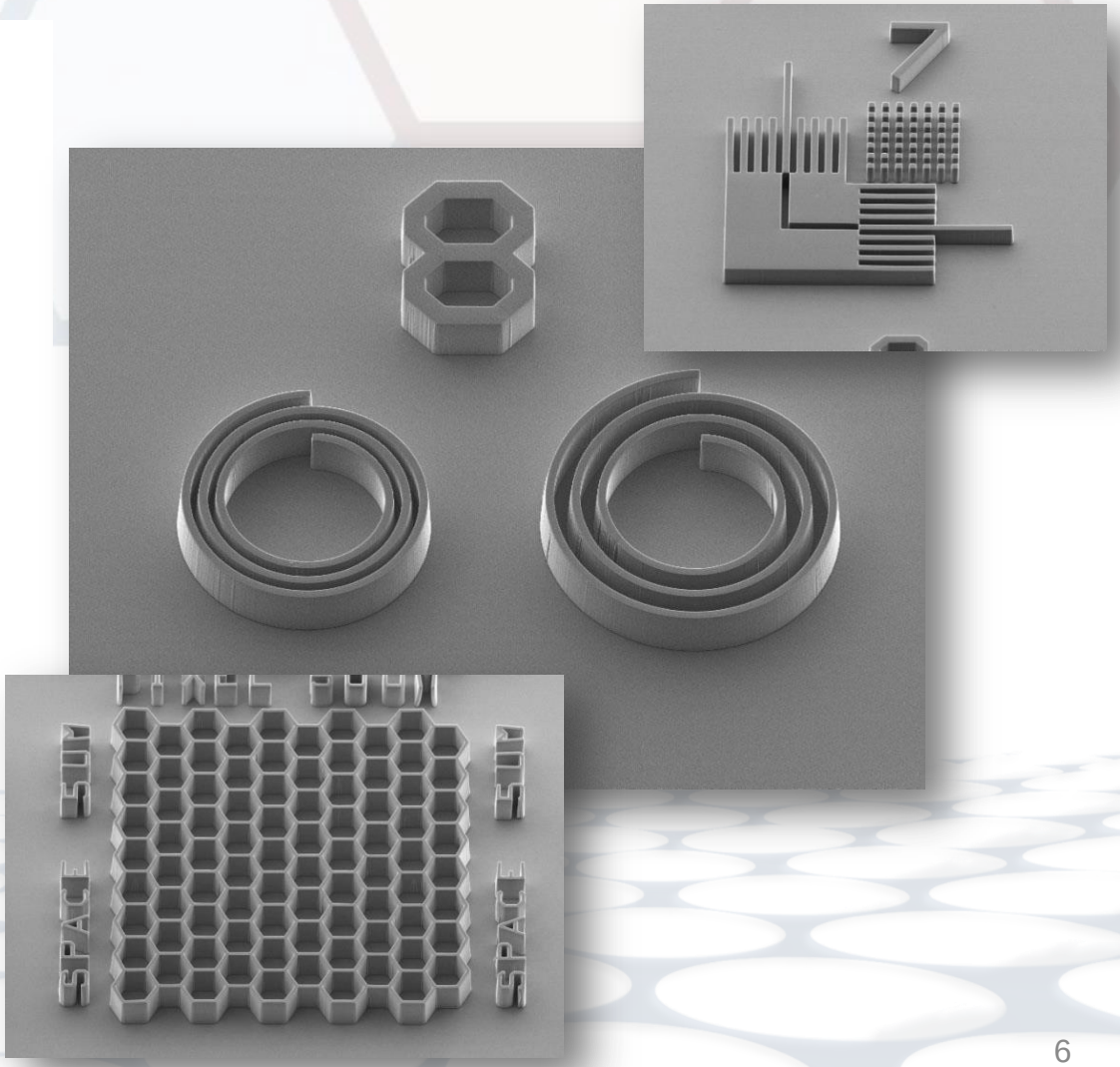
HARE SQ™ is a negative epoxy resist *designed* for Microelectronics

Start with better materials, make a better product.

1. **SUPERIOR CLEANLINESS AND OPTICAL CLARITY**

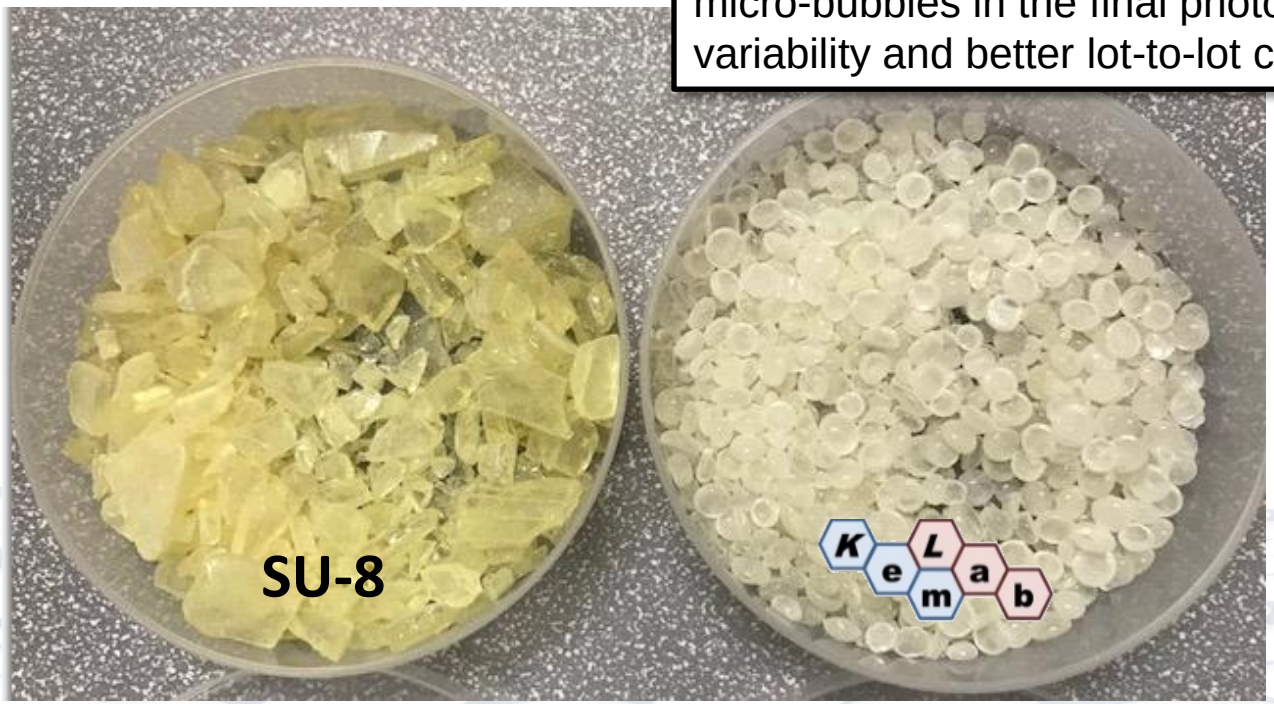
2. **ADDED QUALITY TESTING**

3. **BETTER LOT-TO-LOT CONSISTENCY**

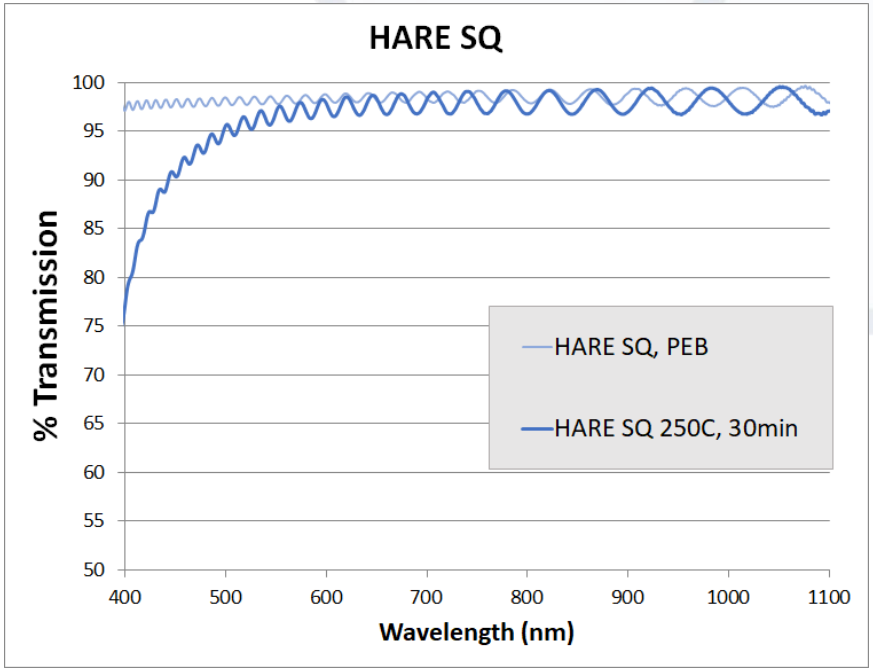


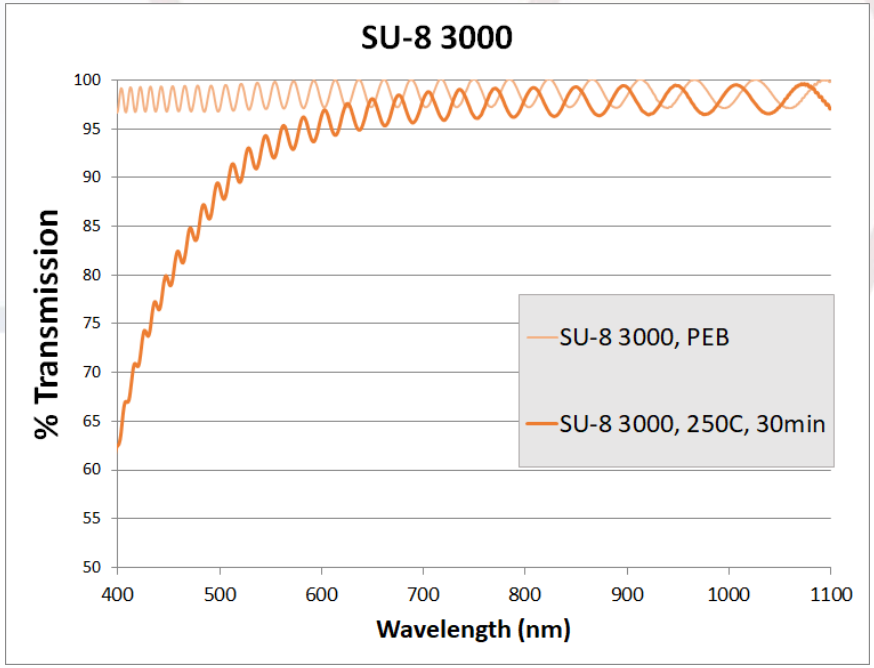
HARE SQ™ HAS SUPERIOR CLEANLINESS AND OPTICAL CLARITY

KemLab HARE SQ™ resin is cleaner and less yellow. This leads to fewer particles, more opacity, and fewer micro-bubbles in the final photoresist. Resulting in less variability and better lot-to-lot consistency.



Optical Properties Comparison - 5μm thickness



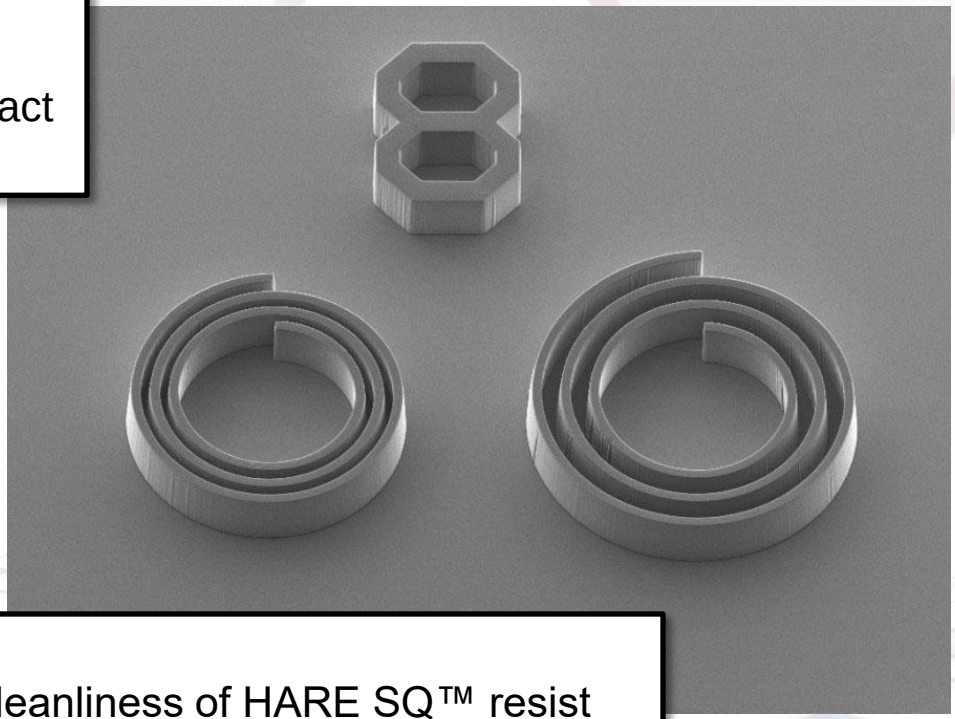


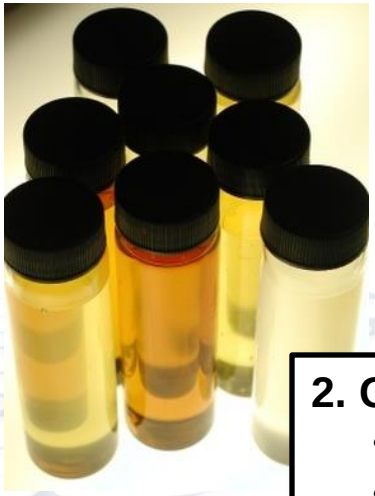
KemLab HARE SQ has improved transparency versus SU-8

HARE SQ™ HAS ADDED QUALITY TESTING

1. Surface Energy

- Indicates cross-link consistency and crosslink density
- Demonstrates adhesion consistency
- Especially relevant to microfluidic applications where fluids come in contact with the polymeric MEMS structure





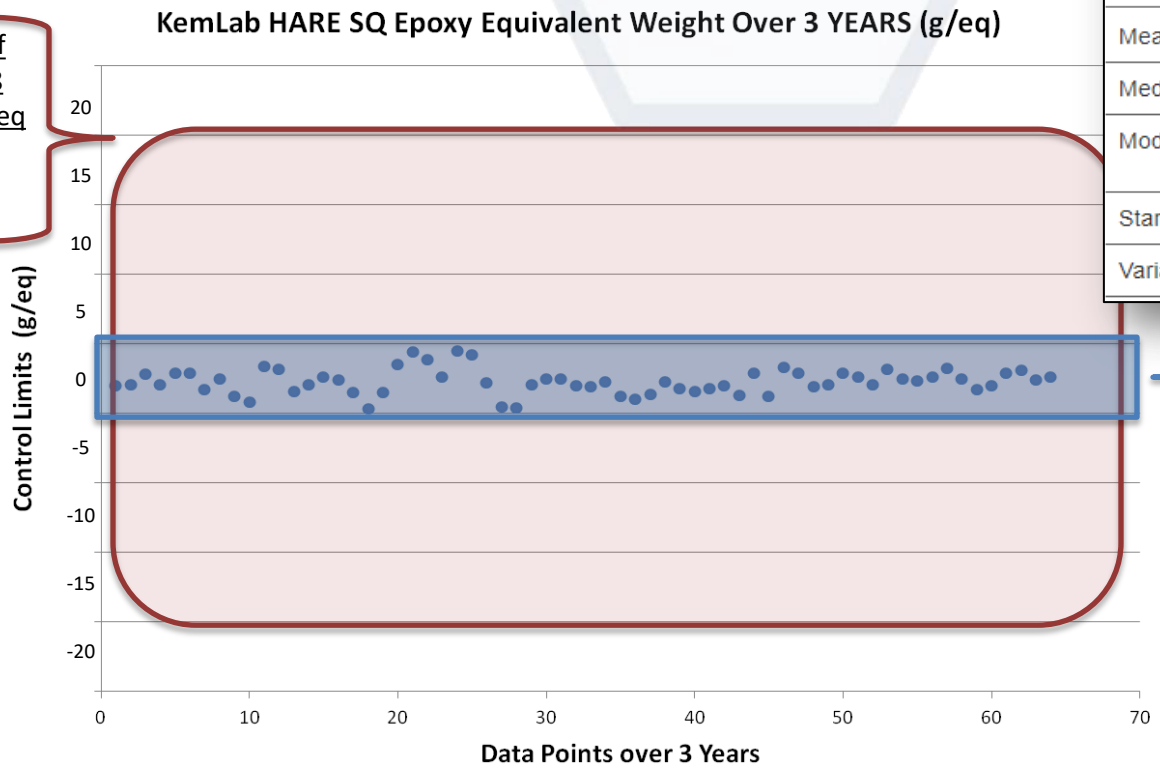
2. Gardner Color

- Demonstrates cleanliness of HARE SQ™ resist
- Ensures lot-to-lot consistency

3 Years of Resin Lot-to-Lot Data Shows High Consistency and Resin Quality

Minimum	min =	195.3
Maximum	max =	199.5
Range	R =	4.2
Size	n =	64
Sum	sum =	12626.54
Mean	$\bar{x}$ =	197.289688
Median	$\tilde{x}$ =	197.3
Mode	mode =	197.1
Standard Deviation	s =	0.890630183
Variance	s^2 =	0.793222123

Spec range of EEW for SU-8 resin is 35 g/eq resulting in variability across lots



KemLab resin data over 3 years shows minimal variability resulting in better consistency lot-to-lot*

** Improved Lot-to-lot reproducibility leads to consistent lithographic performance and crosslinking density.*

HARE SQ™ Certificate of Analysis

H.A.R.E. SQ 25

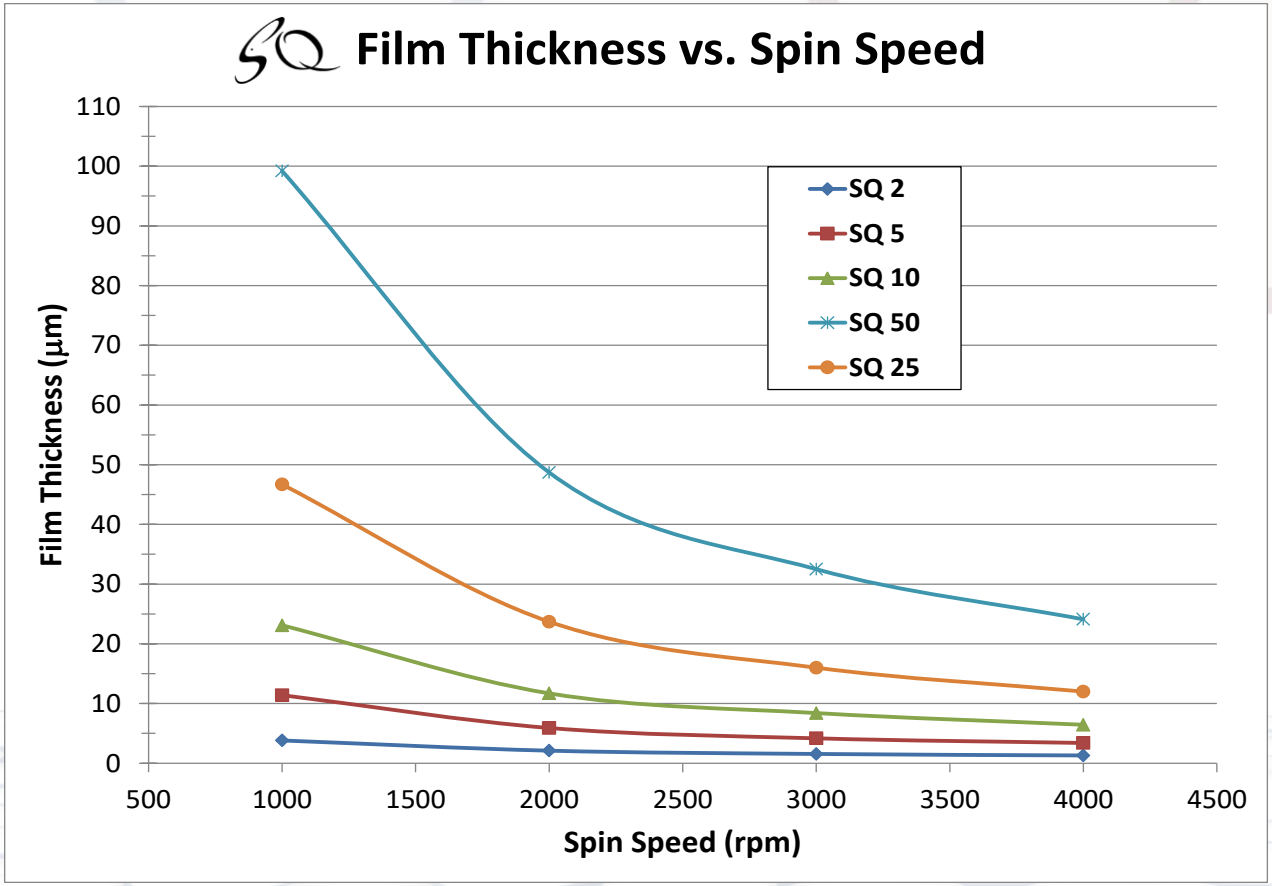
Superior Quality
High Aspect Ratio Epoxy

Certificate of Analysis

Batch Number	**P2-064**	Manufacture Date	May-2018
Certified	5/11/2018	Expiration Date	May-2019

Procedure	Unit	Lower Limit	Upper Limit	Result
Viscosity (25°C) Procedure: QC-002	cst	2350	2550	2446
Film Thickness vs Target Procedure: QC-003	%	-5.0	+5.0	-3%
✓ Surface Energy (crosslinked) Procedure: QC-008	dynes	26	30	27.5
✓ Appearance: Gardner Color Scale Procedure: QC-009	color unit	n/a	3	Pass
Filtration Level Procedure: QC-006	microns	1.0	1.0	1.0

HARE SQ™ Spin Curve



HARE SQ™ Properties

Product Details

Property	KemLab HARE SQ™
Tone	Negative
Max Single Coat Thickness, µm	100
Aspect Ratio	10:1
Storage Condition / Shelf Life	15-30°C / 1 yr

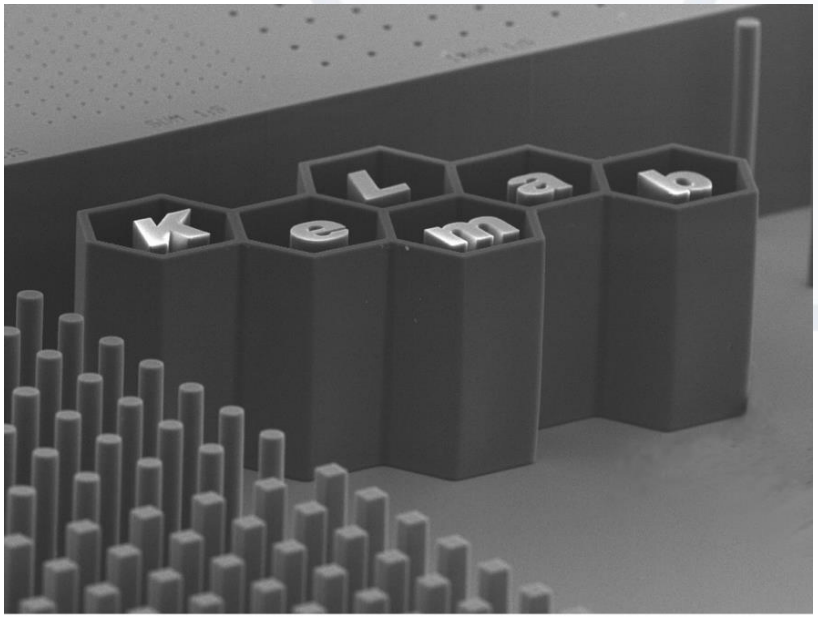
Mechanical Properties

Property	KemLab HARE SQ™
Softening Point / Tg	210°C
Young's Modulus	2.0 GPa
Coeff. of Thermal Expansion, CTE	52 ppm/°C
Tensile Strength	60 MPa
Thermal Conductivity	0.2 – 0.3 W/m·°K
Thermal Stability	315°C

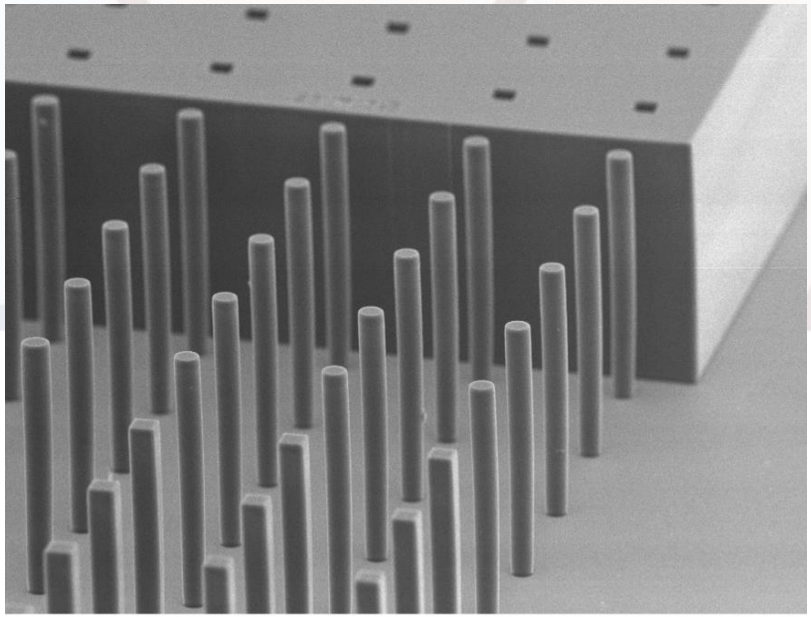
Electrical Properties

Property	KemLab HARE SQ™
Dielectric Constant (relative), 1 GHz, 50% RH	4.0
Dielectric Loss, 1 GHz	~0.02
Dielectric Strength (V/µm)	112
Volume Resistivity (Ω·cm)	~2.5 x 10^{16}

Double Coat Process for Thick Films >100 µm



HARE SQ 50, 70d, 150x, 200 µm FT



HARE SQ 50, 65d, 130x, 200 µm FT

HARE SQ 50 – Double Coat Process for Thick Films

Double Coat Process of HARE SQ 50 for 200 micron film thickness

Coat: 800 rpm, 30 sec, 5 sec spread

Soft Bake: Coat 1: Hotplate 1: 65°C / 5 minutes (put directly on hotplate 2, do not let cool)

Hotplate 2: 95°C / 15 minutes

Coat 2: Hotplate 1: 65°C / 10 minutes (put directly on hotplate 2, do not let cool)

Hotplate 2: 95°C / 30 minutes

Exposure Dose (broadband): 225 mJ/cm^2 (Use optical cut-off filter at 360 nm for best results)

Post Exposure bake: Hotplate 1: 65°C / 2 minutes (put directly on hotplate 2, do not let cool)

Hotplate 2: 95°C / 15 minutes

Film Relax Time: 60 minutes minimum

Develop: SQ Developer. For best results, use 2 immersion baths

Bath 1: 40 minutes immersion

Bath 2: 10 minute immersion

Rinse: IPA (Isopropyl alcohol). If there is any scum (white precipitate), then immerse in developer again for another 5 -10 minutes