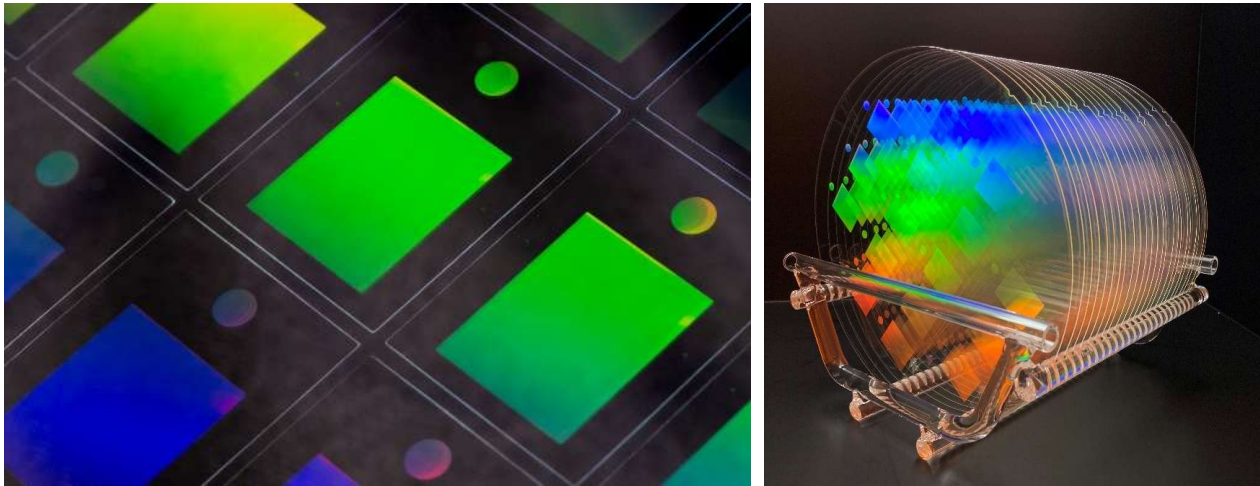




High RI Imprint and Working Stamp Resins for UV-NIL



ACW's Imprint resins for UV-NIL



Images courtesy EV Group (evgroup.com)



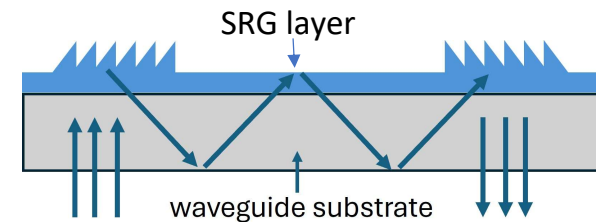
ACW's Imprint resins: LuxNIL[®] Resins

Surface Relief Grating (SRG) Resins for Optical Waveguides

- **Refractive index of 1.70 to 2.0 at 589 nm**
- **Very Low Loss values: <math><0.2 \text{ dB/cm}</math> (125 nm thickness)**
- Tunable RI to meet customer's most specific requirements

High performances of cured resin

- Demonstrated on existing platforms
- Good mechanical and chemical stability
- Excellent environmental stability
- Optically clear in the visible spectrum down to 400 nm
- Inprintable at thickness as low as 200 nm imprint layer
- Manufacturing Ready
- Patented technology





LuxNIL[®] Resins

- Resin type: Acrylate binder with inorganic nano-particles
 - High RI derives from TiO₂ NPs with organic coatings
- Solvent: PGMEA (50 to 65%)
- Refractive Index at 589 nm: 1.70 – 2.0
 - Tunable to customer specifications
- Designed for spin coating



LuxNIL[®] Resins

LuxNIL [®] Resin	F-19	G-91	G-93	G-94
RI at 589 nm	1.85	1.91	1.95	1.99
Abbe No (V_d)	18	16	16	14
Haze (%)*	0.04	0.04	0.05	0.04
Transmission (%)* [§]	88	86	86	85
Clarity (%)*	100	100	100	100

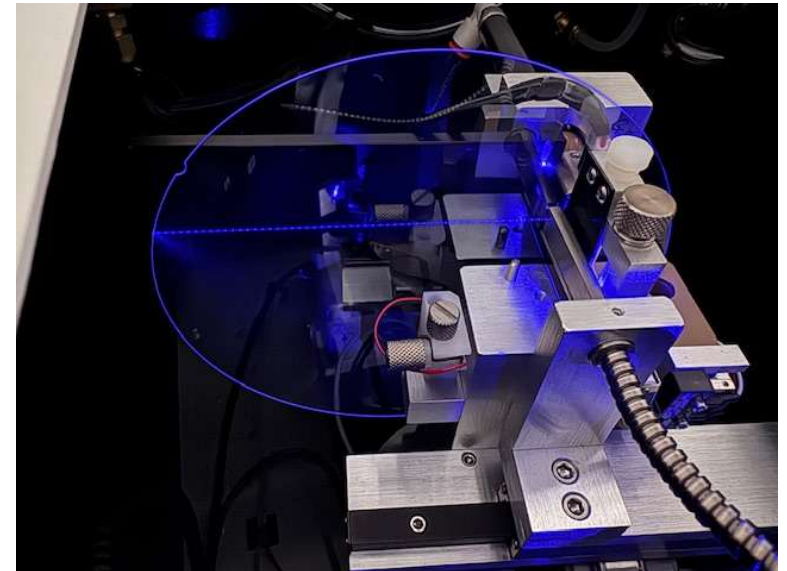
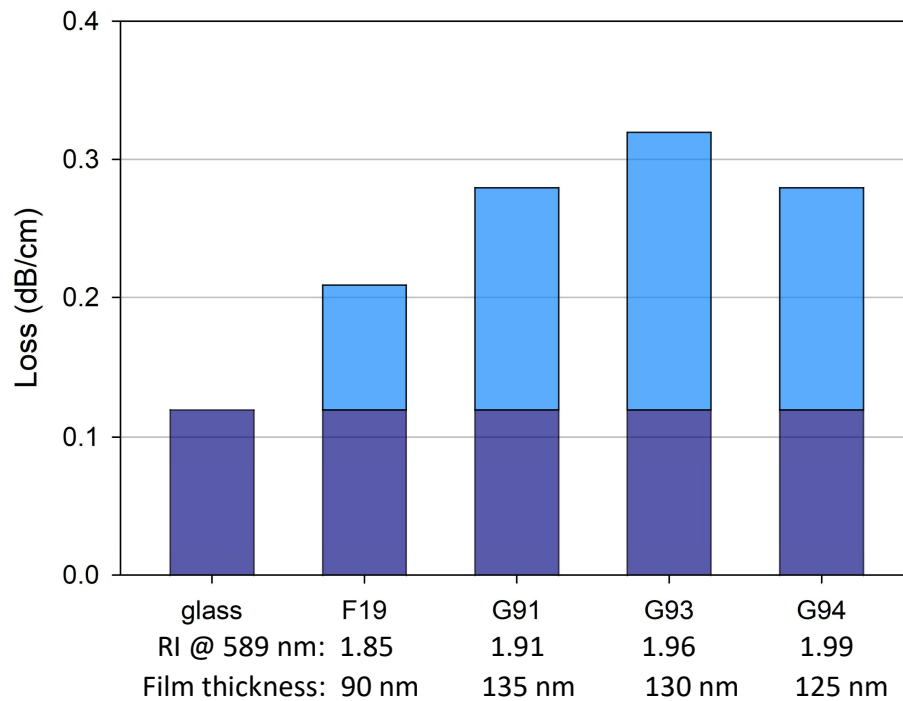
*250 nm film on glass

[§] no correction for surface reflection



LuxNIL[®] Resins Have Low Optical Loss

457 nm laser; 60° propagation angle; n = 2.0 glass, 0.50 mm





ACW's Solution for Sun-light Stability

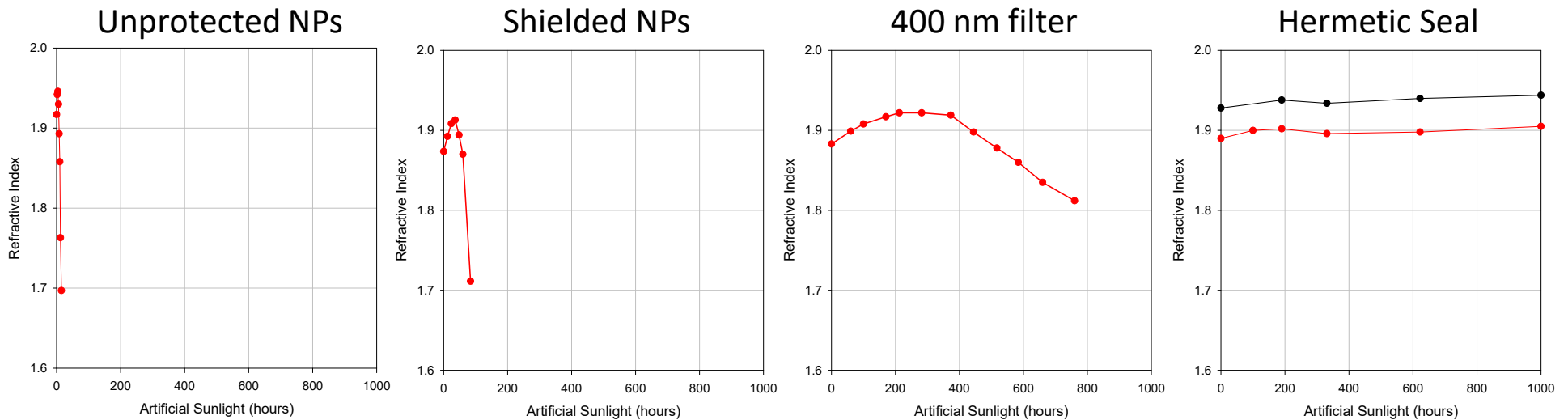
ACW demonstrates elimination of TiO_2 photo-reactivity by hermetic sealing



Q-Sun® Daylight Q
300 – 800 nm 365 W/m²
>2X average sunlight

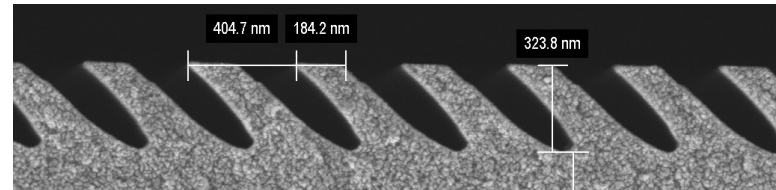
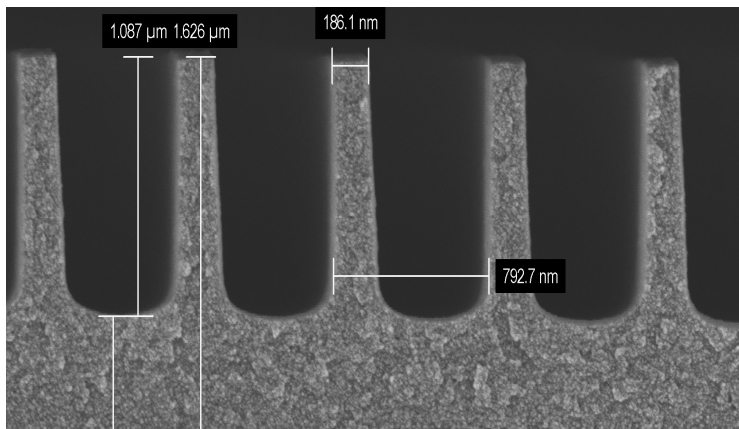
LuxNIL resin – 600 nm thick

glass sheet





ACW's Working Stamp Resins for UV-NIL



Images courtesy EV Group (evgroup.com)

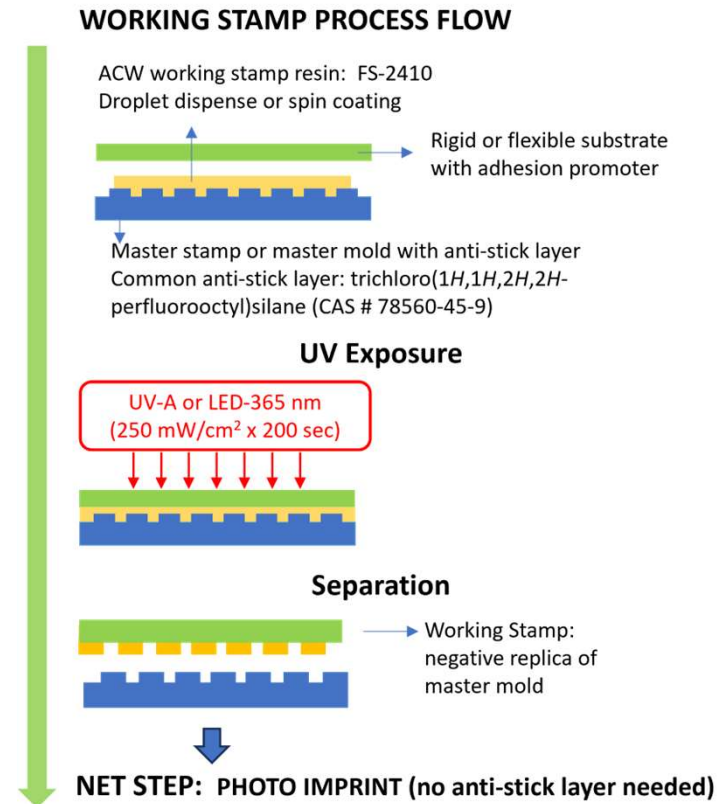


ACW Working Stamp Resins

- **PFAS-FREE**
- Anti-Stick layer is **NOT REQUIRED** for imprints on the Working Stamp
 - Reduces the number of process steps
- Excellent chemical resistance
 - Resists etching by aggressive imprint resins
 - Minimizes height gain for multiple imprints
- Excellent mechanical and thermal stability
 - Survives multiple imprints

Working Stamp Process Flow

- The working stamp resin is dispensed on the master stamp with anti-stick layer
- A backplane is mated
 - Flexible (PET) or rigid (glass)
- The working stamp resin is cured
- The working stamp is demolded and used for UV imprinting





Soft stamp for nano-imprinting

- A soft stamp (PET backplane) is used
 - ACW working stamp resins are UV cured
- Advantage of soft stamp: low cost
- Advantage of UV curing vs. heat (PDMS)
 - Low cost and high replication accuracy
 - Multiple imprints
- ACW working stamp resins for nano-imprint
 - Acrylate base: FS-2400, FS-2410
 - Epoxy base: WS-104





ACW's Working Stamp Resins

Property	FS-2400	FS-2410	WS-104
Chemistry	acrylate	acrylate	epoxy
Dispense process	droplet	spin coat or droplet	spin coat or droplet
Viscosity (cps @ 25°C)	600 to 700	400 to 500	250 to 350
LED 365 nm dose (J/cm ²) oxygen free or between two substrates	10-20 (200 mW/cm ² x 100 sec)	10-20 (200 mW/cm ² x 100 sec)	38-50 (250 mW/cm ² x 150 to 200 sec)
Young's Modulus (GPa)	2.5	1.5	1.2
Tg (°C)	155	171	70
Contact Angle of water in air (°)	107	99	116
% transmission (400 to 1000 nm)	>90	>90	>90



ACW's WS resin Tests (with EV Group)

Binary Gratings

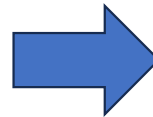
- EVG UV-A (inorg.)
- EVG UV-OA-R18 (org.)
- mrt mr-NIL213 (org.)
- ACW LuxNIL P285
- ACW LuxNIL Q70

High Aspect Ratio

- EVG UV-A
- ACW LuxNIL P285

Slanted Gratings

- EVG UV-A
- ACW LuxNIL P285



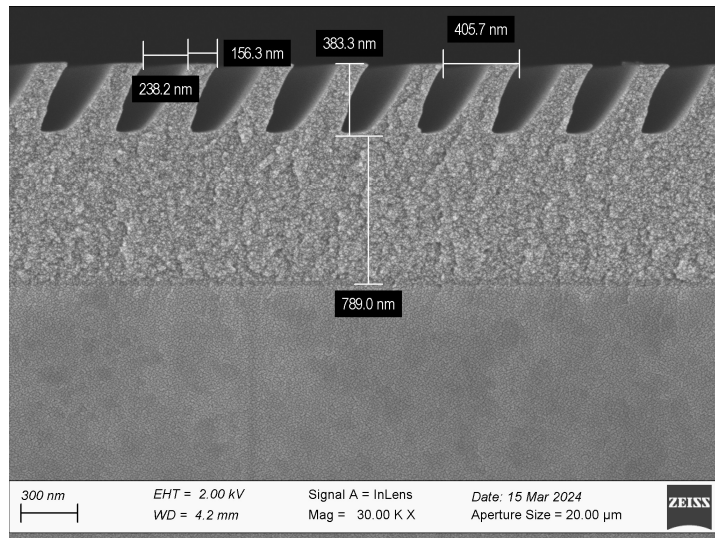
- Roller speed for LuxNIL[®] with ACW's WS resin was 25%
 - 5% speed is standard
 - Increased productivity
- Smooth and easy detachment even for slanted features

Slanted Gratings

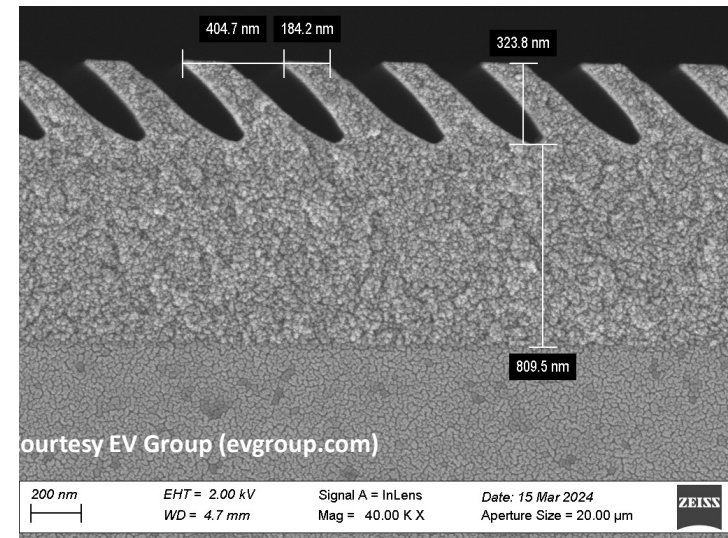


LuxNIL[®] P285 resin imprinted with working stamps made with ACW's WS Resin
(NOTE: Residual layer thickness not optimized)

30° Angle



45 ° Angle



Images courtesy EV Group (evgroup.com)

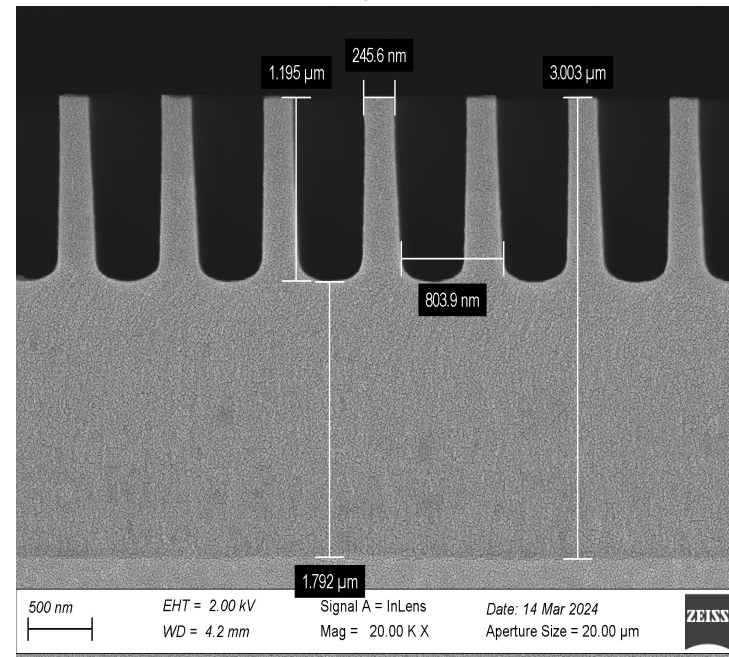
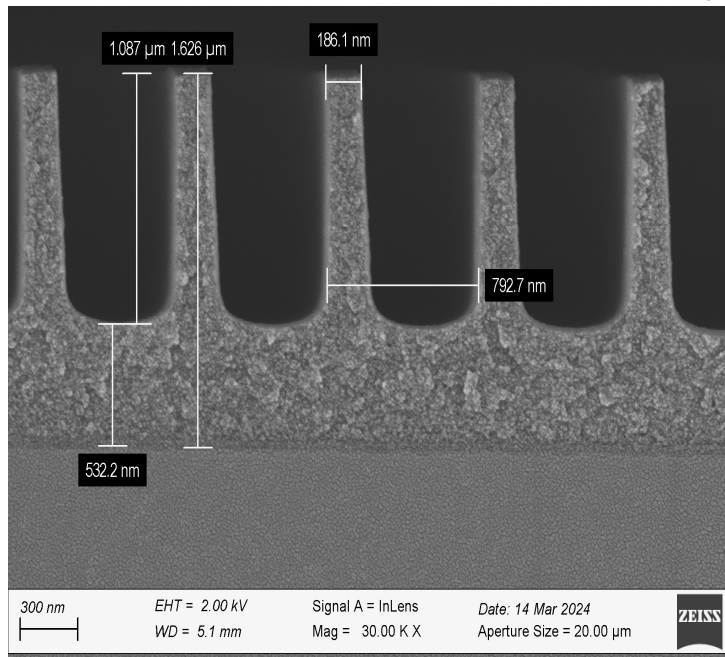


High Aspect Ratios

LuxNIL[®] P285 resin

EVG's Inorganic-filled resin

(NOTE: Residual layer thickness not optimized)



Images courtesy EV Group (evgroup.com)



ACW Resin Solutions for UV-NIL

- **LuxNIL[®] resins: UV imprint resins**
- *Refractive index: 1.70 to 1.99 at 589 nm*
- *Low Optical Loss / Non-Yellowing*
- *ACW demonstrates encapsulations/hermetic seals provide sunlight protection to TiO₂ high RI UV-NIL resins*
- *Manufacturing ready*
- **ACW working stamp resins**
- *PFAS-Free*
- *Suitable for both flexible and rigid backplane*
- *Resins are now available to customers for evaluation*
- *Contact ACW for more information: LuxNIL@addisoncw.com*



Contact Information

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