Introduction of Low Outgassing and Ionic Content High-Performance Light & Moisture Conformal Coating

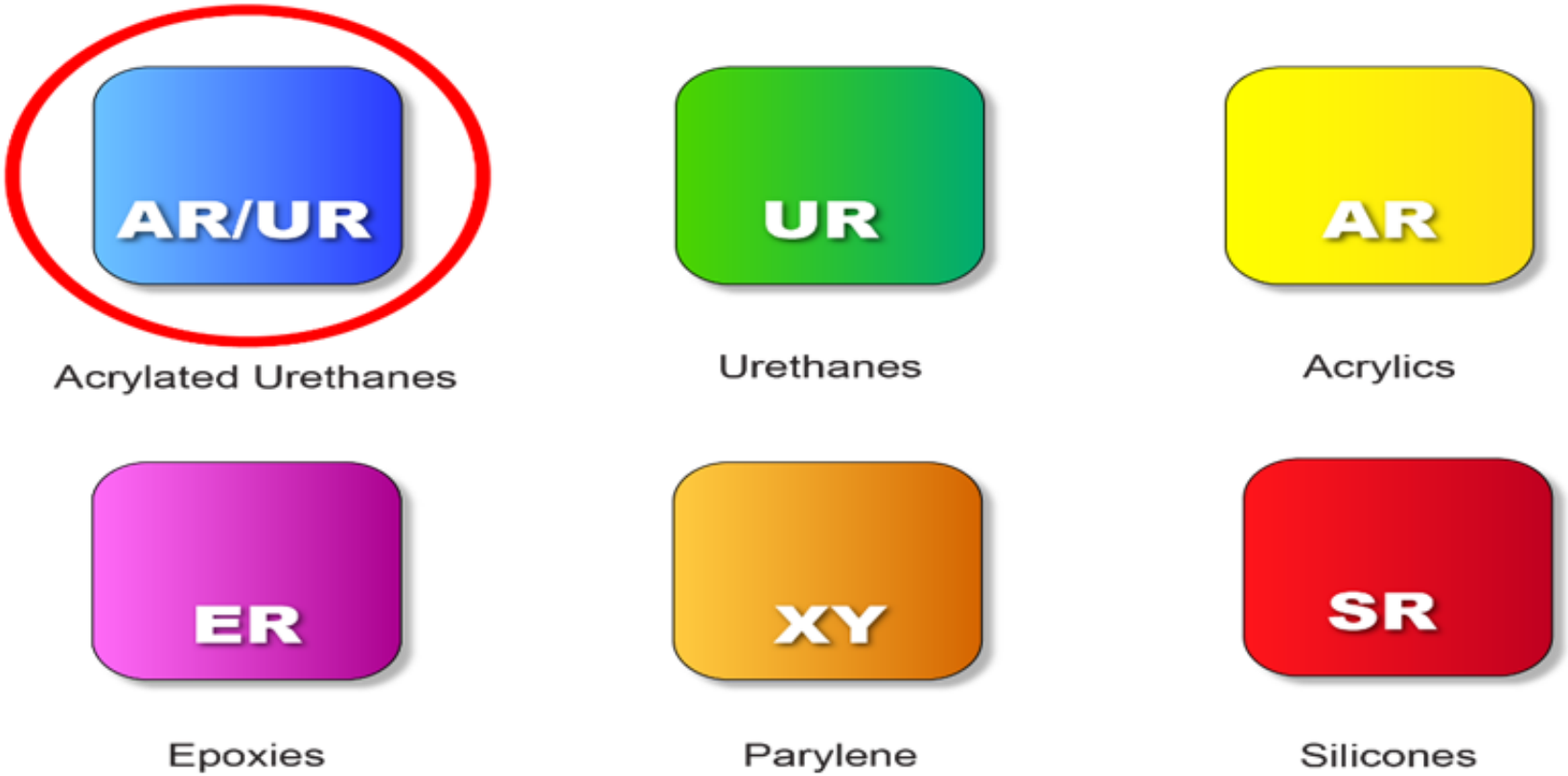
May 2023

Presented by Ginny Hogan, Global Business Development, Sr. Mgr.

SPACE TECH EXPO USA

DYMAX®

Conformal Coatings by Resin Type



Conformal Coating Tests

- Low ionic content
- Thermal stability and low outgassing
- Good substrate wetting
- Good reliability
  - Heat/humidity resistance
  - Corrosion resistance
  - Thermal shock and cycling resistance

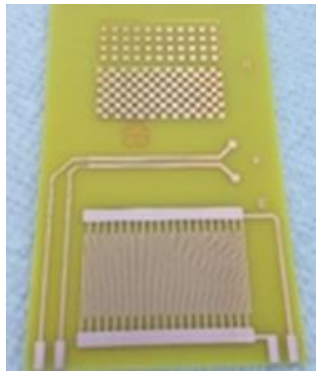
Critical for Aerospace and Defense Applications

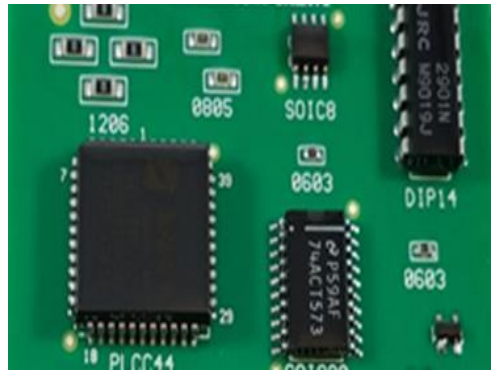
Description of the Conformal Coatings Tested

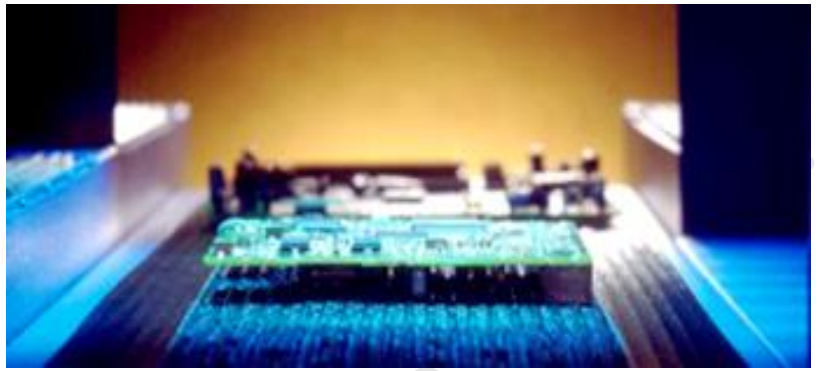
	Chemical Classification	Curing Mechanism	Solvent (%)	Viscosity (cP)
LM1	Urethane Acrylate	Light + Moisture	None	820
LM2	Urethane Acrylate	Light + Moisture	None	1100
LH1	Urethane Acrylate	Light + Heat	None	2300
LH2	Urethane Acrylate	Light + Heat	None	160
SA	Acrylic	Air drying	~60%	200
SP	Polyurethane	Air drying	~60%	200

Preparation of the Conformal Coatings

- Dry film thickness: ~75-90 μm
- Light Curable Conformal Coatings:
  - Broadband light curing conveyer
  - 2500 mW/cm^2 light intensity
  - 1.2 m/min – 3 m/min
  - Secondary heat cure coatings were exposed to 120°C for 30 minutes for heat curing
  - Coatings were kept at 25°C / 50% R.H. for 7 days before testing
- Solvent Based Conformal Coatings
  - Air dried at 25°C / 50% R.H. curing for 7 days







Ionic Content of Coatings

- MIL-STD 883 method 5011.7

	LM1	LM2	LH1	LH2	SA	SP	Requirements
Total ionic content (mS/m)	**3.60**	27.82	7.26	12.57	**0.26**	7.83	≤ 4.50
Hydrogen ion content, pH	**4.13**	3.14	3.77	3.53	**5.53**	3.79	4.0 ≤ pH ≤ 9.0
Chloride (ppm)	**1**	**5**	**0**	**2**	**0**	**4**	≤ 200
Sodium (ppm)	**0**	**49**	**44**	**5**	**19**	**42**	≤ 50
Potassium (ppm)	**3**	**14**	**5**	**0**	**3**	**13**	≤ 50
Fluoride (ppm)	**0**	**0**	**0**	**3**	**1**	**0**	≤ 50
Bromide (ppm)	0	0	0	0	0	0	-
Nitrate (ppm)	15	15	9	8	0	0	-
Phosphate (ppm)	2	931	0	0	0	0	-
Sulfate (ppm)	0	19	0	8	0	0	-
Ammonium (ppm)	11	16	11	21	5	5	-
Lithium (ppm)	0	0	0	0	0	0	-
Magnesium (ppm)	0	0	0	0	0	0	-
Calcium (ppm)	0	0	0	0	0	0	-

- LM1 and SA are the only coatings meeting the requirements

Thermal Weight Loss of Coatings

- Thermal stability: Heat to 200°C with 10°C/min - MIL-STD 883 method 5011.7

	LM1	LM2	LH1	LH2	SA	SP	Requirement
Weight Loss at 200°C (%)	0.67	1.81	2.12	2.81	0.25	1.87	≤ 1%

  - LM1 and SA are the only coatings that are able meet MIL-STD 883 method 5011.7

- Outgassing: 125°C and 6.7×10^{-3} Pa vacuum, 24h - ASTM E595

	LM1	LM2	Requirement
Total Weight Loss (%)	0.90	3.15	≤ 1%
Collected Volatile Condensables (%)	0.02	0.54	≤ 0.1%

  - LM1 meets ASTM E595 requirements

Summary

	LM1	LM2	LH1	LH2	SA	SP
Ionic Content, MIL-STD 883 Method 5011.7	✓	✗	✗	✗	✓	✗
Thermal Stability, MIL-STD 883 Method 5011.7	✓	✗	✗	✗	✓	✗
Outgassing, ASTM E595	✓	✗	-	-	-	-
Thermal Dimensional Stability	✓	✓	-	-	✗	✗
Heat & Humidity Resistance	✓	✓✓	-	-	✓	✗
Salt Spray Corrosion Resistance	✓	✓	-	-	✗	✓
Sequential Thermal Shock and Cycling MIL-STD 883 methods 1010 and 1011 -condition C	✓	✗	-	-	✓	✗

https://go.dymax.com/space-tech-wp020

Authors

- Dr. Aysegul K. Nebioglu, Dymax Corporation
- Nilsa Moquette, Dymax Corporation
- Virginia Hogan, Dymax Corporation

Stay Connected

Visit us online | dymax.com

Follow us |

DYMAX®