Cavity Electronic Packaging with Near Hermetic Lid-Sealing Adhesives-Coatings for

- Optoelectronics and Imaging Devices
- 5G and Ultra-High Frequency Microwave Devices
- Micro-Electro-Mechanical Systems (MEMS) and Sensor Devices

Near-Hermetic Cavity Electronic Packaging with Moisture Barrier Lid-Seals

True Near-Hermetic Lid-Seal Solutions with Work-Flow Friendly Melt-Flow Ideally Suited for High Volume Inline Cavity Electronic Packaging:

Cost effective, near-hermetic cavity electronic packaging of electronic devices are becoming more important for the commercial electronics used in electric vehicles, smartphones, and sensor devices driving automation of all kinds. Reliability of these imaging and sensor devices depends on the cavity keeping out of corrosive environment such as moisture in combinations with ionic impurities and corrosive gases.

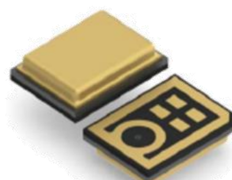
- Lid-Sealing adhesive and/or coating-sealant must have the capability keep out the moisture that have a very small kinetic molecular diameter similar to He. FLUOROSEAL® has now been proven to match that of LCP to block moisture and corrosive gases from penetrating the near-hermetic lid-sealing into the cavity.
- FLUOROSEAL® is available in dispensable and B-stageable paste ease of individual cavity packaging. They are also available in B-staged film forms to allow wafer-scale and panel-scale cavity packaging. Processing flexibilities are designed for different batch or inline sealing processes.
- FLUOROSEAL® can also be applied along and outside lid-seal area for blocking out moisture and corrosive gases.
- RoHS, REACH and WEEE compliant to meet UL94V-0 rating.

True Near-Hermetic Lid-Seal Solutions with Work-Flow Friendly Melt-Flow and Curing Ideally Suited for High Volume Inline Cavity Electronic Packaging Production:

What distinguishes AIT's FLUOROSEAL® cavity electronic packaging lid-seal adhesive in comparison to the traditional epoxy lid-seal adhesive besides its molecular structure designed to block moisture and corrosive gases from penetration is its production workflow cycle friendly for batch and inline production.

- Dispensable and B-stageable FLUOROSEAL® lid-seal adhesives have long floor life of more than 5 days.
- Easy B-staging at below 60°C to form dry to touch solid adhesive on LCP, metallic, ceramic or glass lids for ease of handling and pick-and-place lid-placement during production.
- Once B-staged, the lid-seal adhesive is dry and ambient storable for 12 months for ease of shipping and usage.
- Instead of maintaining constant pressure on the lid during curing cycle for the batch production with the use of traditional B-staged epoxy adhesive, B-staged FLUOROSEAL® lid-seal adhesive has high "heat melt green strength" to allow releasing placement fixture after initial cycle lid-placement within the isothermal nitrogen backfilled chamber environment. Example of inline workflow for high volume cavity lid-sealing production:
    1. Preheat the cavity packages without lids in an array fixture-plate to 150°C.
    2. Move the heated fixture-plate with cavity packages into nitrogen backfilled and controlled chamber.
    3. Pick-and-place lids with B-staged adhesive onto each package with adequate placement pressure of > 5psi to induce adequate adhesive flow.
    4. Remove the array of cavity packages with lid-seal for completion of curing at 150°C hot stage.

LCP molded packages sealed with FLUOROSEAL® B-staged lid-sealing adhesive has proven to unparalleled moisture barrier reliability



SiP (System-in-Package) MEMS devices required cavity-based packaging with cost effective moisture barrier lid-sealing

Optical imaging devices required glass window and moisture barrier lid-sealing for preventing water condensation

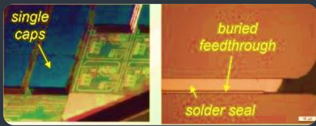
FLUOROSEAL® conformal coating have been proven to block moisture and other corrosive gases

High Moisture Barrier Lid-Sealing Adhesives-Coatings for Cavity Electronic Packaging:

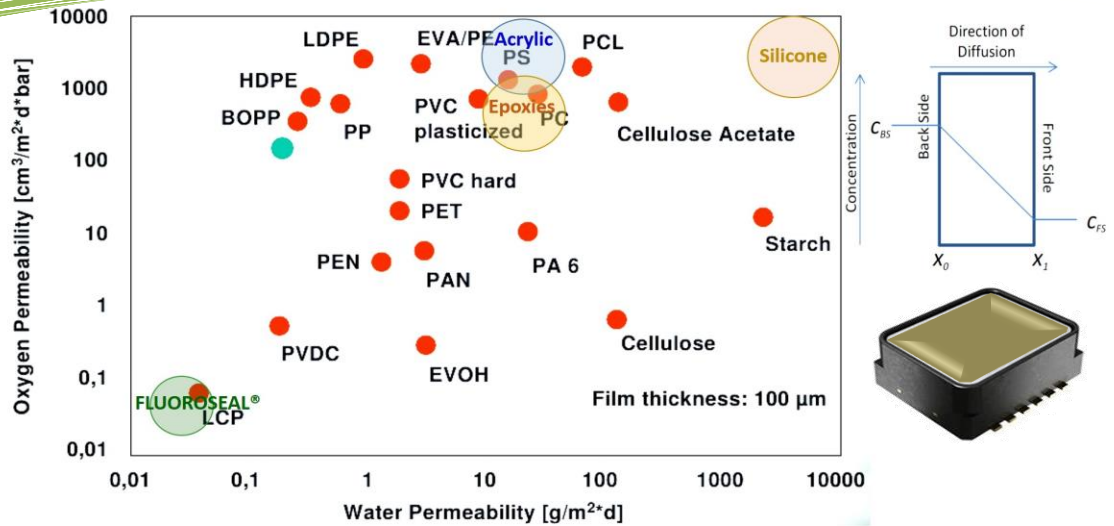
- FLUOROSEAL® B-Stageable Paste Adhesives
- Instant Melt-Bonding FLUOROSEAL® Film Adhesives
- FLUOROSEAL® Coating-Sealant as Moisture Barrier

Near-Hermetic Cavity Electronic Packaging with Low Temperature Low Moisture and Corrosive Gases Permeability Adhesive-Sealant Lid-Sealing:

- Traditional AuSn and glass-frit lid-sealing provides outstanding hermetic lid-sealing with 80-100µm sealing width. Costs and lid-sealing at near 300°C are some of its limitations for high volume commercial applications.



- Traditional epoxy adhesive lid-sealing for near-hermetic applications using controlled pressurization and lower temperature of less than 150°C have been proven reliable enough for most applications.
- For some of more advanced applications such as optical imaging devices and automotive electronic sensor devices that required high moisture barrier and higher temperature operation to 175°C, lid-sealing adhesive with much lower moisture permeability and higher temperature tolerance are critical for their successes.
- FLUOROSEAL® paste and film are proven lid-sealing adhesive and coating that are molecularly designed to meet the more stringent requirement. They block moisture that carries with it the corrosive sulfur and other acidic gases. while contribute close to zero sodium, chloride and other circuit damaging ions.

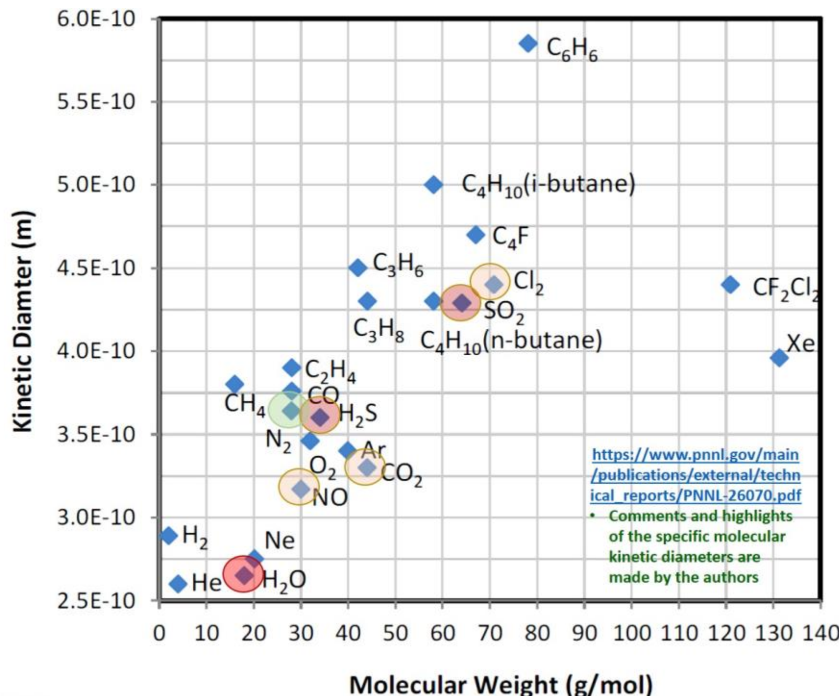


https://www.slideshare.net/TopasAdvancedPolymers/high-aroma-barrier-films-for-food-packaging

Proven Moisture Blocking Cavity Electronic Packaging Lid-Sealing Adhesive and Coating:

Epoxies lid-seal adhesives or coatings allow moisture to penetrate and also retain from 0.3-1.0% of moisture in the material. Silicone has a very low contact angle when what drop on its surface and thus very hydrophobic. However, it also has 10-20 times higher moisture permeability due to its relatively high volume and large molecular pores free-spaces. Moisture penetration coupling with ionic impurities and/or corrosive gases cause corrosions.

FLUOROSEAL® paste and film adhesives are molecularly designed to have low moisture permeability to effectively block moisture from penetration when the cavity is backfilled with nitrogen atmosphere. This moisture blocking capability has been measured to match that of the liquid crystal polymers to form near hermetic seal for air cavity electronic packages.



Nitrogen is an inert gas that has a larger molecular kinetic diameter than moisture. It is ideal backfilling gas inside the cavity in blocking moisture penetration after lid-sealing.

- Keeping the sealing cavity temperature same as surrounding air, and
- blanketing the surrounding air outside of the cavity with nitrogen,

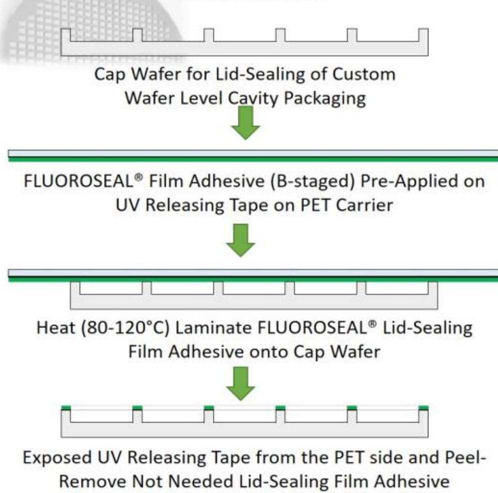
are critical for pin-hole free and reliable device lid-sealing.

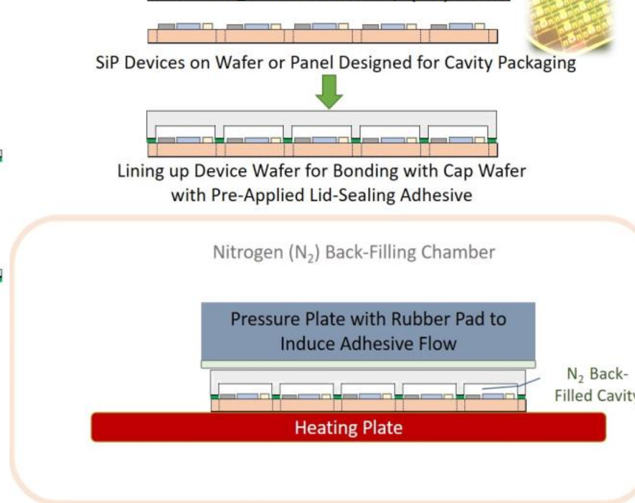
NOTES:

- Smaller molecular kinetic diameter is easier to penetrate the lid-sealing adhesives and/or barrier coatings
- Barrier against H_20 is even better barrier against larger kinetic diameter of the more corrosive gases such as H_2S and SO_2
- He molecule has similar kinetic diameter to that of water vapor molecules and thus a good media for leaks comparison

FLUOROSEAL® Lid-Sealing Film and Paste Adhesives for Module and Wafer-Scale Cavity Electronic Packaging:

- Proven Moisture and Corrosive Gases Barrier
- Instant Melt-Bonding for High Volume Production
- Electrically Insulating or Conductive Pastes and Films





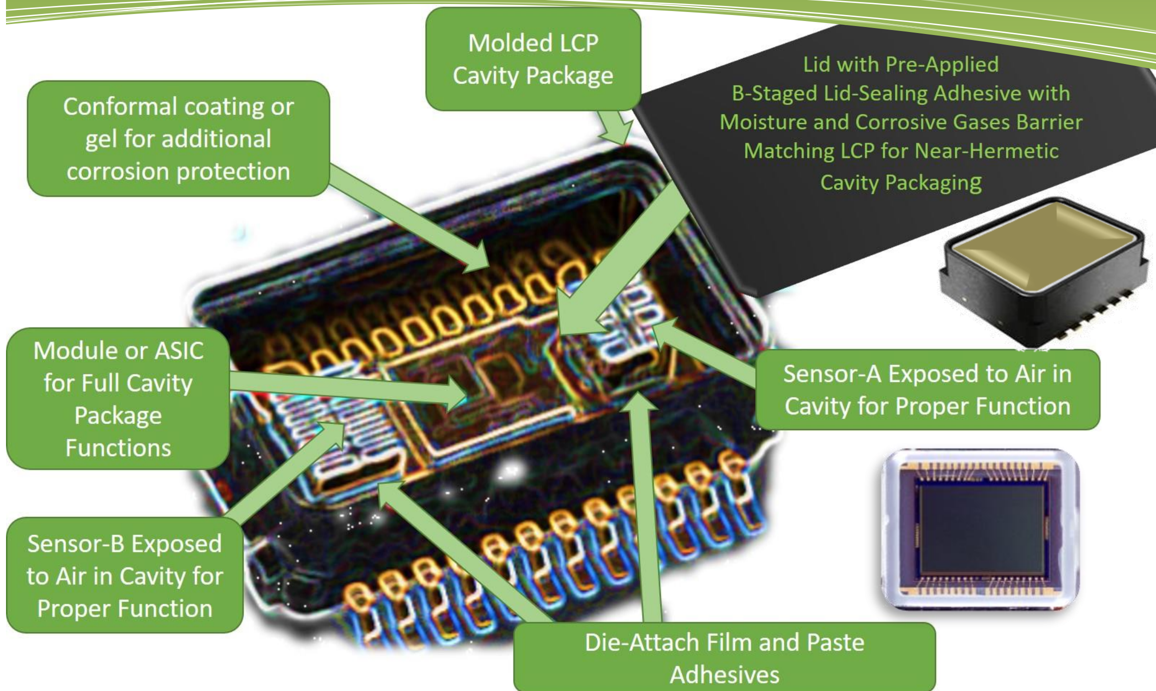
PROPERTY	FLUOROSEAL® LS-LCXP7450 B-staging Adhesive	FLUOROSEAL® LS-LCXP8450 B-staging Adhesive	FLUOROSEAL® LS-CXP7450 Film Adhesive	FLUOROSEAL® LS-TP7150 Film Adhesive
Electrical Resistivity	$>2X10^{14}$ Ω-cm	$<5X10^{-4}$ Ω-cm	$>2X10^{14}$ Ω-cm	$>5X10^{14}$ Ω-cm
Moisture Absorption (% by Weight)	0.04	0.03	0.04	0.03
Moisture Permeability (gm/m^2-day)	<0.06	<0.08	<0.06	<0.03
Material Form Factors	Dispensing Paste	Dispensing Paste	Melt-Bonding and Post-Curing	Melt-Bonding Film Adhesive
Glass Transition T_g (°C)	240/-50	240/-50	240/-50	-50
Shear Bonding (psi)	>3,500	>2,500	>3,500	>1,200
Modulus of Elasticity (psi)	100,000	200,000	100,00	8,000
Cured Density (gm/cc)	1.5	4.0	1.5	1.8
Thermal Conductivity	> 0.2 W/m-°K	> 10 W/m-°K	> 0.2 W/m-°K	> 0.2 W/m-°K
Thermal Expansion Coefficient (ppm/°C)	85	55	85	90
Maximum Continuous Operation Temp (°C)	>175	>175	>175	>125 with shear >175 without shear
Decomposition Temp(°C)	>400	>400	>400	>400
Recommended Drying-Curing Temp (°C/Min)	B-Stage @60°C/30 min, Instant Melt-Bonding 150°C/5psi, Post-Curing with no Pressure	B-Stage @60°C/30 min, Instant Melt-Bonding 150°C/10psi, Post-Curing with no Pressure	Instant Melt-Bonding 150°C/5psi, Post-Curing with no Pressure	Instant Melt-Bonding 150°C/8psi, No Post Curing

Moisture and Corrosive Gases Blocking Lid-Sealing Adhesives:

- FLUOROSEAL® lid-sealing adhesives are available in paste and film formats with conductive variations in case EMI shielding is required.
- In comparison to epoxy lid-sealing adhesives, FLUOROSEAL® lid-sealing adhesives are molecularly engineered to have 10-fold less moisture absorption and more than 100-fold lower in moisture and corrosive gases permeability to provide true near-hermetic sealing.
- FLUOROSEAL® lid-sealing adhesives are hydrophobic and unlike most epoxies are intrinsically free of ionic impurities that could reduce circuit reliability.
- FLUOROSEAL® lid-sealing adhesives have outstanding shear-bond strength and high temperature molecular stability for continuous use >175°C to meet the more stringent automotive electronic devices.
- Engineered molecular structure with low and high Tg molecular components for stress absorption with proven outstanding thermal cycles, shock and low temperature exposures.
- Once FLUOROSEAL® lid-sealing paste adhesive is dispensed and B-staged, it can be shipped at ambient and use within 12 months.
- B-staged FLUOROSEAL® lid-sealing adhesive can be instantly melt-bonded and post-cure without applied pressure for high volume inline manufacturing.

Near Hermetic Cavity Electronic Packaging Solutions:

- Conformal Coatings for Circuit Protections from Modules to Devices
- Lid-Sealing Coatings-Sealants
- High Temperature and Ionic-Free Die-Attach Film and Paste Adhesives
- UV Curing FLUOROSEAL® Film Adhesive



Cavity Electronic Packaging Applicable Adhesives-Coatings-Sealants:

FUNCTION	AIT PART#	Moisture, Water, Electrical other Relevant Properties
Conformal Coating ("Parylene Replacement")	SC7130-CC	• Optically transparent with ultra-moisture and corrosive gases blocking • Outstanding protection for water, moisture, salt-fog, corrosive gases and UV for exposed plastics and protecting metals from tarnishing and rust • Conforms to properties in IPC-CC-830, IPC-TM-650, MIL-I-46058, ASTM-D-1005, UL94-V0
Optical Glass Lid Rim (Coating-Sealant)	LS-SC7150	• For use on bonded lid seal areas for near-hermetic sealing protection • Effective moisture and corrosive gases barrier at 100µm thickness • Outstanding molding or potting compound moisture barrier over-coating
Transparent UV Blocking Coating	SC7130-UVB	• Optically transparent coating with proven UV blocking capability for display and color-fast protection • Outstanding protection for moisture, salt-fog, corrosive gases and UV for exposed plastics and protecting metals from tarnishing and rust
Stress and Ionic Impurities Free Adhesive Films	CXP7459-LB CXP8450	• Molecular flexible with high bond strength for large area die and module bonding in cavity packages that can be used continuously >175°C • Can be used for lid-seal bonding when pre-applied onto bonding areas • Outstanding thermal conductivity
UV Curing Lid-Sealing Adhesive Film	LS-UVF7350	• Instant melt-bonding to follow with UV curing for strong lid-sealing • Outstanding moisture and corrosive gases barrier at >100µm bonding width • Can be pre-applied as B-stageable liquid paste to form lid-sealing film

About AI Technology, Inc.:

Since pioneering the use of flexible epoxy technology for electronic packaging in 1985, AI Technology (AIT) has been one of the leading forces in developing advanced materials and adhesive solutions for electronic interconnection and packaging with more than 30 patented technologies.

With the introduction of AIT's patented solar materials and solutions (US8,394,650 and others pending), AIT offers UV blocking and UV transparent coatings as well as proven materials for cavity packaging, electronic board level and system level barrier protection against moisture, corrosive gases, salt-fog and water immersion.

As a pioneering force in electronic adhesives and coatings, besides being the first with proven self-supporting film adhesives for stack chip applications, AIT has recently successfully proven its patented (US11,222,864) clean releasing wafer processing temporary bonding adhesives.

AI Technology, Inc. (AIT) offers one of the most comprehensive lines of advanced materials for packaging and protection from chip to board level:

- Die attach film and dicing die-attach film adhesive for chip stacking and high-power microelectronic devices
- Die-Attach films and pastes for extreme high temperatures, extreme stress management requirements and extreme high-power applications
- Moisture and corrosive gases blocking conformal coating protections of sensitive circuits.
- UV blocking protective coatings in addition to the moisture and corrosive gases blocking as over-coating for displays, color-fasting, bridges and other structural coating exposed to the sun, rain and environments.
- Thermal interface materials including greases, gels, adhesives, patented compressible phase-change pads, high compressibility and conforming "gum-pads" with unparalleled performance
- EMI/RFI mitigation material solutions with conductive caulks and adhesives
- Advanced flexible and Insulated Metal Circuit Substrates for camber-free modules
- Insulated metal substrate for high temperature and high-power modules

AIT develops and manufactures its product in two separate ISO 9001:2015 certified totaling over 100,000 sq ft on 16 and 18 acre facilities in New Jersey, USA. AIT also has worldwide sales representation along with a manufacturing and service center in Shenzhen, China.