



**AL-3349, 3351, 3355**

**Optical Epoxy Siloxane**

For photonics and microelectronics

#### ÅNGSTRÖMLink™ KEY FEATURES

- Compatible with CMOS fabrication techniques
- Fast UV cure
- Very low shrinkage
- Very low, stable dielectric
- Excellent chemical and thermal stability
- Low moisture absorption

ÅngströmLink AL-33xx series polymers are optically clear with excellent stability and processing capabilities. These products feature a siloxane (silicon-oxygen) backbone with epoxy functional groups. This combination provides for extremely stable mechanical, electrical and optical properties at, or after exposure to, high temperature.

The AL-33xx polymers are 100% solids. At room temperature, these polymers have long pot life. The uncured polymers are soluble in a variety of solvents for spin coating and produce a very uniform coating thickness across large areas (12 inch wafers). Curing can be accomplished with both UV and heat. These materials can be photo-imaged and etched for pattern delineation processes. The cured polymers have excellent chemical and solvent resistance.

These products are supplied in light-sensitive protected bottles. These polymers offer a service temperature range of -40°C to +350°C (+400°C for short periods of time).

## Applications

Wafer level micro-optical components

Photoimageable waveguides

Microlenses

Dielectric films

## Benefits

UV and/or Heat cureable

Good adhesion to silicon dioxide, copper and aluminum

Low optical absorption loss - 0.05 – 0.3 dB/cm  
(depending on wavelength)

Thermally stable, up to 350°C  
(400°C for short periods of time)

Excellent chemical resistance

Refractive indices of 1.49, 1.51 and 1.55

(revision 04/2013)

For more information on this or other products and their availability, please contact us at:  
1-800-IS-FIBER (473-4237); (508) 992-6464; Fax us at (508) 991-8876, or via email at [sales@focenter.com](mailto:sales@focenter.com)  
Please visit us on the web at [WWW.FOCENTER.COM](http://WWW.FOCENTER.COM)

| Property (at 25°C unless noted)          | Test Method       | Typical Value                                  |
|--|-------------------|--|
| <b>Cure Processing Characteristics</b>   |                   |  |
| Uncured mixed viscosity                  | ASTM D-1084       | 3000 cP typical                                |
| Cure Time / Heat Cure                    | Visual            | 135°C minimum for 1 hr                         |
| Cure Time / UV Cure                      | Visual            | 700mJ for a 15-20µ film                        |
| <b>Cured Mechanical Properties</b>       |                   |  |
| Appearance                               | Visual            | Clear  |
| Physical Consistency                     | Visual            | Glassy Solid                                   |
| Hardness                                 | Shore D           | 70-75  |
| Modulus                                  | -                 | 5 GPa (@ 20nm nanoindent)                      |
| Shrinkage                                | -                 | 0.2%, typ                                      |
| Specific Gravity                         | ASTM D-1217       | 1.15   |
| <b>Cured Thermal Properties</b>          |                   |  |
| Glass Transition                         | DSC               | 330°C, Slowly degrades above 400°C             |
| Coefficient of Thermal Expansion         | -                 | 55 x 10 <sup>-6</sup> cm/ °C (0-300°C)         |
| Moisture absorption                      | 85/85             | < 0.5%   |
| Thermal decomposition point              | TGA               | > 400°C  |
| <b>Cured Electro-optical Properties</b>  |                   |  |
| Leakage                                  | -                 | <10 <sup>-8</sup> A/cm <sup>2</sup> @ 2 – 4 MV |
| Volume Resistivity                       | ASTM D-257        | > 10 <sup>15</sup> ohm-cm, est.                |
| Dielectric Constant                      | -                 | 2.4 - 2.8                                      |
| Refractive Index, 589 nm                 | ASTM D-1218       | 1.52   |
| Refractive Index vs. Temperature, 589 nm | ASTM D-1218       | - 3.9 x 10 <sup>-4</sup> /°C                   |
| Refractive Index vs. Wavelength          | prism coupler     | (see chart)                                    |
| Optical Absorption                       | spectrophotometer | (see chart)                                    |

## Recommended Cure Schedules

### UV Cure

|               |                           |
|---------------|---------------------------|
| Exposure Type | Broadband UV light source |
| Dose          | 10mW / 12s                |

### Thermal Cure (See Application Note #1 below)

|                     |   |
|---------------------|---|
| Minimum Temperature | 135°C                                       |
| Recommended Range   | 150 - 165°C                                 |
| Cure                | 45 minutes @ 155°C                          |
| Snap Cure           | 175°C for 15 seconds                        |
| Anneal              | 90 minutes @ 250°C (under inert atmosphere) |

### UV plus Thermal

|               |                    |
|---------------|--------------------|
| Exposure Type | Fusion "H" Bulb    |
| Dose          | 12 mW / 5 seconds  |
| PEB           | 30 minutes @ 135°C |

## Application Notes

- 1) To obtain best optical quality films, use the thermal cure version of these materials.
- 2) RPMs for spinning vary between 300 and 6000.

## Recommended Solvents

MEK, PMA or Mesitylene, AL-33xx polymers can be diluted to 20 to 80% solids.

## Typical Adhesion Promoters

HMDS and AP-3000 (See paragraph on Substrate Preparation)

## Recommended Etchant

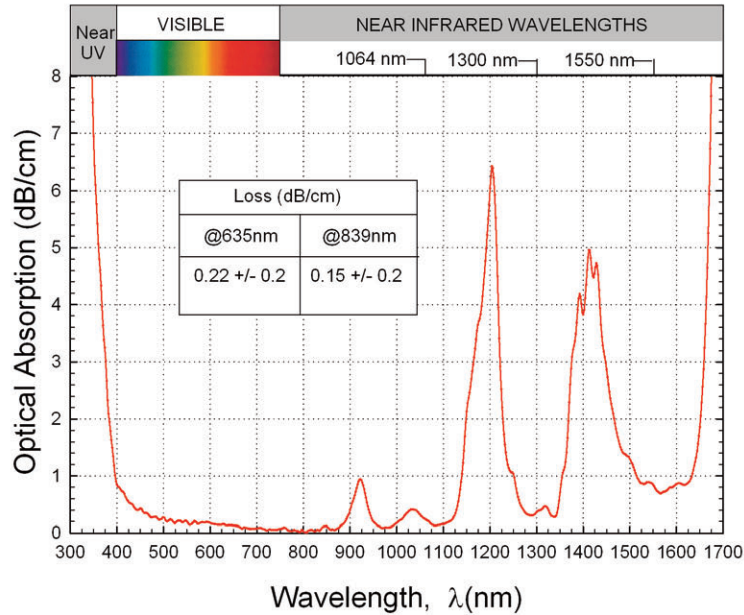
CF<sub>4</sub>/O<sub>2</sub> reactive ion etching. Wall smoothness can be controlled by adjusting etching parameters.

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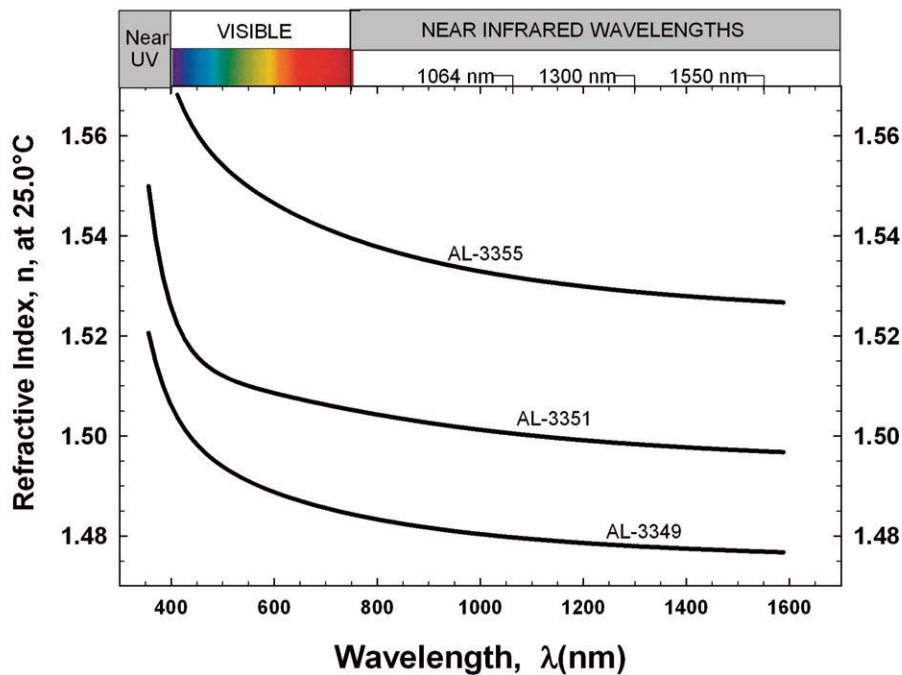
## Optical Absorption vs Wavelength

### AngstromLink Optical Epoxy Siloxane AL-3349, AL-3351 and AL-3355



## Refractive Index vs Wavelength (25°C)

### AngstromLink Epoxy Siloxane AL-3349, AL-3351 and AL-3355



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## Substrate Preparation

Clean substrates using suitable industrial techniques for cleaning electro-optics. Oxide grown layers typical of CMOS fabrication techniques are frequently used as substrates. Typical adhesion promoters are HMDS and AP-3000. If hydrocarbon solvent cleaning (e.g. acetone, toluene) is used, a final rinse with reagent grade isopropanol is recommended. If aqueous detergent cleaning is used, multiple final rinses with de-ionized water or a single rinse with reagent grade isopropanol is recommended. Improved adhesion to some substrates may be obtained using suitable primers such as HMDS and AP-3000.

## Cleanup

AL-33xx materials may be removed from surfaces by first wiping off excess gel with a suitable dry lint-free wipe and then by wiping down the surface with a lint-free wipe soaked with acetone. If the surface material is incompatible with acetone (acetone can soften or crack some plastics) use isopropanol. If acetone residues are undesirable, the clean-up process should be completed with a final rinse with reagent grade isopropanol. The user is responsible for compliance with all applicable regulations governing disposal of waste materials as indicated in the MSDS.

## Packaging

AL-33xx polymers are supplied in light-sensitive protected bottles. Standard quantities are 20g, 50g, 100g, 250g, 500g and 1kg. For other container options contact Fiber Optic Center.

## Specifications

The typical properties quoted on this product data sheet should not be used as a basis for preparation of product specifications, and may change without notification. Because we cannot anticipate or control the many different conditions under which this information and our products may be used, we cannot guarantee the applicability of this information or the suitability of our products in any individual situation. Consult Fiber Optic Center for assistance with establishing specification limits and test conditions. Statements concerning the possible use of our products are not intended as recommendations to use our product in the infringement of any patent.

## Shelf Life

AL-33xx materials have a limited shelf life (6 months from date of manufacture when stored in its unopened original container under the storage temperature range noted on the product label). Use of a product after the expiration date shown on the package, or use of a product which has been improperly stored, may result in improperly cured material.

## Warranty

AL-33xx materials are sold without warranty, express or implied. Fiber Optic Center expressly disclaims any liability for incidental or consequential damages resulting from use of this product.

## Safety

Consult the Material Safety Data Sheet (MSDS) for AL-33xx materials before use. These materials are industrial products, designed for use only by qualified laboratory or production personnel.

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## For Special Quotes and Technical Consultations

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