

CHEMISTRY THAT MATTERS™



SABIC'S SPECIALTIES BUSINESS

# GET MORE FOR YOUR OPTICAL SENSORS

WITH EXTEM™ AND ULTEM™ RESINS

EASIER DESIGN

SIMPLER ASSEMBLY

LARGER BUILDS



# WHO IS SABIC'S SPECIALTIES BUSINESS?

Leveraging global application technology centers, we provide innovative material solutions to a wide range of partners in the sensor industry based on our deep materials and processing expertise in engineering thermoplastic resins, compounds, sheet and film, filaments and additives. Together we're making "Chemistry that Matters™".

More information on our specialty polymers?  
[www.sabic.com/en/products/specialties](http://www.sabic.com/en/products/specialties)



DISCOVER OUR GOLD EDISON AWARD WINNER:

## EXTEM™ RH RESIN SERIES

EXTEM RH Resin series is a family of near IR transparent thermoplastics that can be micro molded into a wide variety of free form optical lens designs. It has the extraordinary potential to withstand the high temperatures of reflow soldering and can help simplify final product assembly.





# GET MORE FOR YOUR OPTICAL SENSORS WITH EXTEM™ AND ULTEM™ RESINS

A specialized series of EXTEM and ULTEM resins were developed to be well-suited for IR sensor part design and potentially contribute to lower production cost. These near IR transparent thermoplastics have multiple benefits over glass and thermosets. Compared to other thermoplastics the EXTEM RH resin series has the extraordinary potential to withstand the high temperatures of reflow soldering.

To collimate the light, these resins can be molded into a wide variety of free form optical lens designs. Versus glass, they enable the integration of multiple lenses and other parts, and are easily scalable, with cost-efficient production using multi cavity micro molding.

## Easier Design

More complex part designs compared to alternative solutions like glass or thermosets.

## Simpler Assembly

Easy integration of mechanical and optical features to simplify design and assembly for potential cost improvement.

## Larger Builds

Injection molding of thermoplastics can enable high precision manufacturing of complex parts at very large volumes.

## AUTOMOTIVE



## CONSUMER

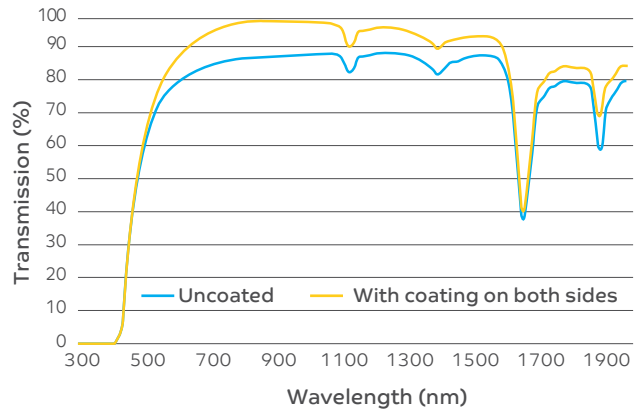


## INDUSTRIAL

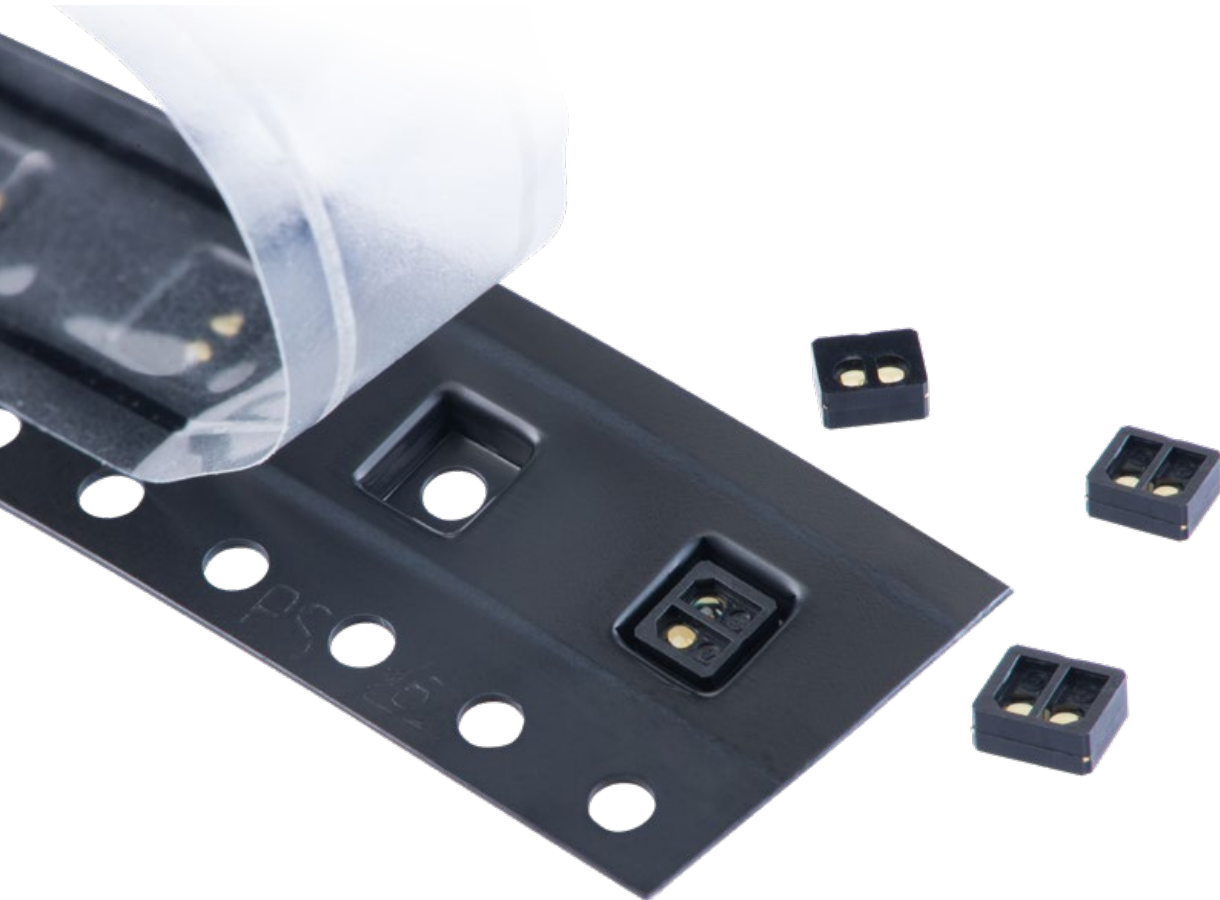
# ACHIEVE EXCELLENT LIGHT TRANSMITTANCE FOR YOUR SENSOR LENSES

**ULTEM™ and EXTEM™ RH resins series show excellent light transmission of over 85% for near infrared optical sensing.**

In addition, anti-reflection coatings (ARC) can help reduce first surface reflection losses, improve contrast and boost the transmission to over 95%. This can enable a higher sensitivity for optical sensors or lower signal losses for fiber optical connectors.



EXTEM RH resin SERIES : External transmission (%) at 1 mm, as a function of wavelength, with and without Anti Reflective Coating (ARC)



EXAMPLE: reel-to-reel overmolded sensor Lenses made from EXTEM RESIN

# GET DESIGN SUPPORT FOR YOUR REFRACTIVE AND DIFFRACTIVE OPTICS

## Increased sensor functionality and complexity do require free form optics, for both refractive and diffractive lenses.

SABIC offers injection molding support and can assist with evaluating global micro molders that have proven capabilities to produce ULTEM™ and EXTEM™ resin components.

Validation tools and multipoint datasets are available for reliability testing, simulation and mold flow analysis. Often JEDEC reflow soldering at 260°C is required during the sensor assembly process and EXTEM RH series do offer the unique capability to withstand this high temperature.

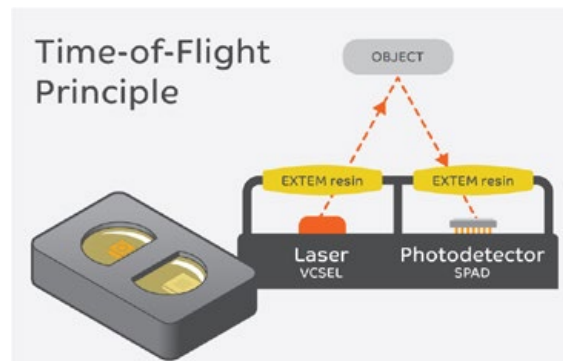
## ULTEM and EXTEM resins are well-suited for refractive optics

ULTEM and EXTEM resins offer more design freedom than epoxy and typically allow for the elimination of the time-consuming curing step.

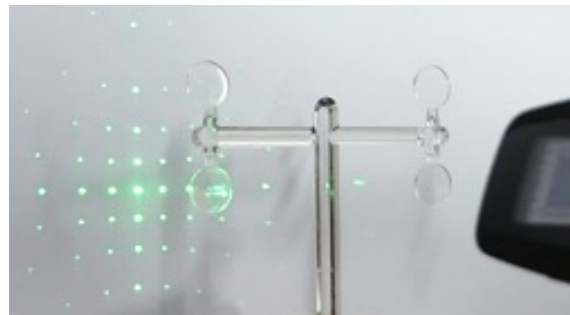
Compared to using glass, expensive polish and grinding steps can be avoided. SABIC's Specialties Business offers support in mold design and processing of our broad portfolio of thermoplastics.

## ULTEM and EXTEM resins can be used for diffractive optics

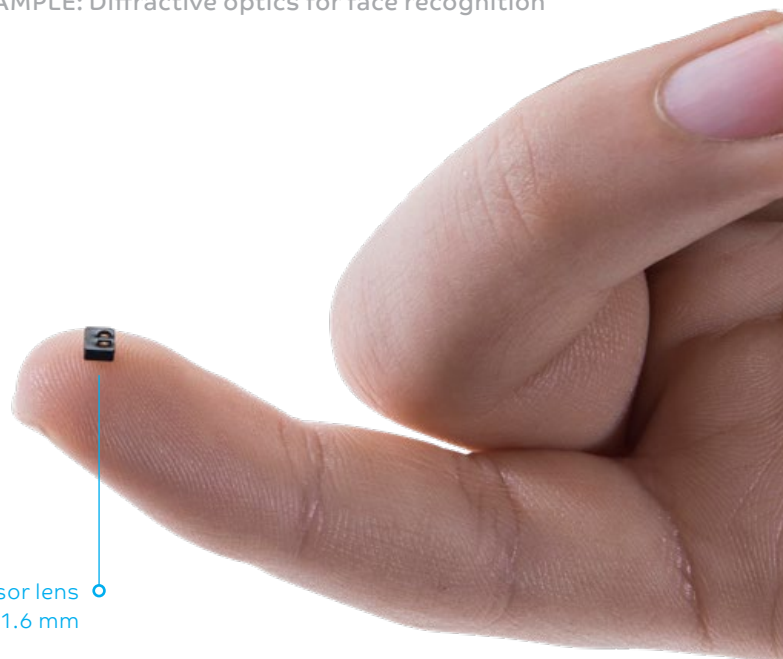
SABIC offers support in various processing technologies for pattern replication, like injection (compression) molding, hot embossing and rapid heat/cool molding. We also offer metrology of surface patterns.



EXAMPLE: Refractive optics in Time-of-Flight sensors using EXTEM resin



EXAMPLE: Diffractive optics for face recognition



Time-of-Flight sensor lens  
5 x 2.5 x 1.6 mm



## TAILOR LIGHT TRANSMISSION AND CUT OFF WAVELENGTHS

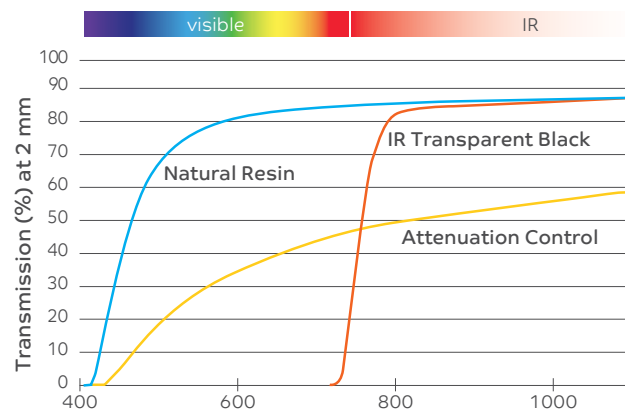
The ability to cut off the transmission of a specific wavelength of light can help reduce stray light and improve the accuracy of the sensor application.

The standard transmission values of ULTEM™ and EXTEM™ resins can be altered through special additives.

For example, transmission can be tailored to a specific value, UV-VIS can be blocked and even full opacification is possible when desired.

### ULTEM and EXTEM RH resins are compatible with all common assembly technologies

SABIC has worked with industrial adhesive suppliers. We can assist in the selection of adhesives with high bonding strength against several substrates.



Tailoring light transmission (ULTEM resin example)

Adhesives suitable for EXTEM RH resin series based optical components

| DELO INDUSTRIAL Adhesives | Substrate | Optics      | Curing method        |
|---------------------------|-----------|-------------|----------------------|
| DELO DUALBOND® OB786      | FR4       | Translucent | Light/Heat           |
| DELO DUALBOND® OB749      | FR4       | Translucent | Light/Heat           |
| DELO DUALBOND® SJ2718     | FR4       | Opaque      | Heat (Light fixable) |
| DELO DUALBOND® LT2208     | Ceramics  | Opaque      | Heat (Light fixable) |
| DELO DUALBOND® AD761      | Ceramics  | Transparent | Light/Heat           |

## DISCOVER MATERIAL AND OPTICAL PROPERTIES OF OUR SPECIALIZED GRADES FOR POTENTIAL USE IN SENSORS

| Property*                    | Standard   | Unit                 | ULTEM™ DT1810EVUCL resin | ULTEM™ 1010UCL resin | EXTEM™ XH1015UCL resin | EXTEM™ RH resin series |
|------------------------------|------------|----------------------|--------------------------|----------------------|------------------------|------------------------|
| Flexural Modulus             | ISO 178    | MPa                  | 3100                     | 3300                 | 2870                   | 2950                   |
| Flexural Strength            | ISO 178    | MPa                  | 120                      | 160                  | 120                    | 110                    |
| HDT, 0.45 MPa                | ISO 75     | °C                   | 190                      | 207                  | 250                    | 269                    |
| Vicat B120                   | ISO 306    | °C                   | 195                      | 212                  | 260                    | 279                    |
| Density                      | ISO 1183   | g/cm <sup>3</sup>    | 1.28                     | 1.27                 | 1.31                   | 1.24                   |
| CTE (-40 to150°C)            | ISO 11359  | 10 <sup>-5</sup> /°C | 6                        | 5.5                  | 5                      | 5                      |
| Transmission at 1mm @ 850nm  | ASTM D1003 | %                    | 89                       | 88                   | 82                     | 87                     |
| Transmission at 1mm @ 1310nm | ASTM D1003 | %                    | 89                       | 89                   | 87                     | 88                     |
| Refractive index 589 nm (nD) | ISO 489    | -                    | 1.655                    | 1.662                | 1.657                  | 1.665                  |
| Refractive index 850 nm      | ISO 489    | -                    | 1.633                    | 1.639                | 1.634                  | 1.639                  |
| Refractive index 1310 nm     | ISO 489    | -                    | 1.620                    | 1.626                | 1.622                  | 1.627                  |
| Abbe number                  | ISO 489    | -                    | 21                       | 21                   | 18                     | 18                     |
| dn/dT (+23°C-140°C) @ 1270nm | ISO 489    | 10 <sup>-5</sup> /°C | -11                      | -10                  | -10                    | -10                    |

\* The data shown are typical properties

## ZEMAX OPTICSTUDIO® PARAMETERS ARE AVAILABLE FOR DESIGN MODELING

Zemax OpticStudio® parameters for EXTEM RH1016UCL resin

| Sellmeier Dispersion Equation for Refractive Index   |         | Temperature Dependence of Refractive Index  |                        |
|--|---------|---|------------------------|
| $n^2 - 1 = \frac{B_1\lambda^2}{\lambda^2 - C_1} + \frac{B_2\lambda^2}{\lambda^2 - C_2} + \frac{B_3\lambda^2}{\lambda^2 - C_3}$ |         | $\frac{\Delta n_{abs}}{n^2 - 1} = \frac{1}{2n} \left[ D_0\Delta T + D_1\Delta T^2 + D_2\Delta T^3 + \frac{E_0\Delta T + E_1\Delta T^2}{\lambda^2 - \lambda_{tk}^2} \right]$ |                        |
| Constants of Sellmeier Dispersion* Formula   |         | Constants of Dispersion dn/dT   |                        |
| B <sub>1</sub>   | 0.56262 | D <sub>0</sub>  | -1.78×10 <sup>-4</sup> |
| B <sub>2</sub>   | 0.56145 | D <sub>1</sub>  | 5.42×10 <sup>-8</sup>  |
| B <sub>3</sub>   | 0.56329 | D <sub>2</sub>  | 2.89×10 <sup>-10</sup> |
| C <sub>1</sub>   | 0.03324 | E <sub>0</sub>  | 1.13×10 <sup>-5</sup>  |
| C <sub>2</sub>   | 0.03264 | E <sub>1</sub>  | -1.98×10 <sup>-7</sup> |
| C <sub>3</sub>   | 0.03307 | λ <sub>tk</sub>   | 0.00                   |

These constants are valid for a temperature range from 30 °C to 120 °C and from 0.5 to 1.7 μm. Dispersion formula returns a valid refractive index between 0.4 and 1.7 μm.

A MEMBER OF



### SABIC ISCC+ CERTIFIED RENEWABLE ULTEM RESIN SOLUTIONS

A new portfolio of bio-based ULTEM™ resins that delivers a lower carbon footprint while offering the same high performance and processability as incumbent ULTEM materials is now available.



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