

CHEMISTRY THAT MATTERS™



SPECIALTY ADDITIVES FOR ELECTRIC VEHICLES

SABIC'S SPECIALTIES BUSINESS



SABIC'S SPECIALTY ADDITIVES FOR ELECTRIC VEHICLES

SABIC, a global leader in engineering thermoplastics, offers a growing portfolio of extraordinary solutions for potential use in electric vehicle and next generation transportation applications. We have leveraged our legacy monomer and thermoplastic polymer development to create specialty polyphenylene ether, bisphenol and dianhydride and imide materials that may be used as an additive in various epoxy, cyanate ester, polyurethane, imides and acrylate formulations.

VALUE PROPOSITIONS



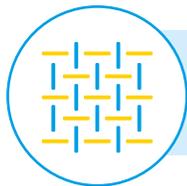
Additive well-suited for epoxies, cyanate ester and free radical cured formulations in PCB laminates for radar, antenna and LIDAR systems which may lower dielectric and signal loss at high frequencies



Enhance dielectric and voltage breakdown strength to address challenges with high voltage operating platforms and advanced format semiconductor architecture for potential use in power electronics and coatings



Improve thermal, mechanical, flame resistance and moisture stability while maintaining toughness and adhesion for potential use in automotive adhesives, coatings and power distribution components including external charging infrastructure



May improve PDIV performance and toughness in enamel varnish and potting compounds while supporting challenging conductor design and retaining high thermal class ratings

NORYL™ PPE (POLYPHENYLENE ETHER) RESIN CHEMISTRY

SABIC's NORYL PPE resin chemistries offer high Tg (up to 215°C), low moisture absorption, hydrolytic stability, flame retardance and low dielectric properties. As part of a thermoset system, NORYL PPE resin chemistries may also improve toughness. Different forms, molecular weight and functionality provide improved solubility and reactivity required in thermoset formulations including epoxy, cyanate ester, polyurethane and acrylate systems. These products may be used in catalytic, free radical, anhydride and certain amine cured systems.

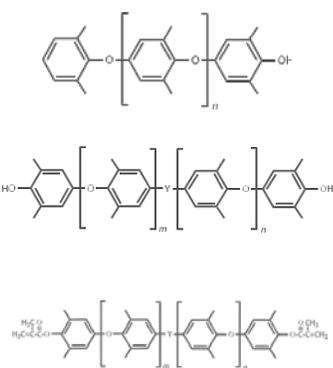
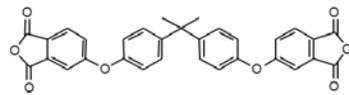
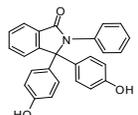
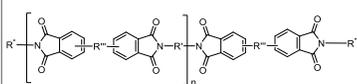
SPECIALTY DIANHYDRIDE & IMIDE CHEMISTRY

SABIC's specialty dianhydride chemistry has a remarkable property profile, including reactivity, chemical functionality, a semi-flexible backbone and high purity. Potential uses include building blocks for polyimide formulations as well as an epoxy hardener. Higher purity grade available for use as a co-monomer in Polyimide synthesis. Functionalized lower Mw telechelic versions of our polyetherimide resins also available as thermoset additives for various formulated systems.

SPECIALTY BISPHENOL CHEMISTRY

SABIC's specialty bisphenol chemistry is built on a legacy of special monomer technology. With a higher heat aromatic backbone, the monomer and its functionalized derivatives may provide higher heat and lower shrinkage compared to other thermoset systems or phenolic chemistries.

ADDITIVES PORTFOLIO

<p>NORYL™ PPE GRADES</p> 	<p>NORYL SA120/SA110A RESIN Tg: 160°C Mw: 2400 g/mol Limited solubility in MEK</p>	<p>Lower molecular weight may allow improved blending for:</p> <ul style="list-style-type: none"> • Styrenic based adhesives • Styrenic based rubber formulations
	<p>NORYL SA90 RESIN Tg: 135°C Mw: 1700 g/mol Improved solubility in MEK</p>	<ul style="list-style-type: none"> • Can achieve single phase system in various epoxy, polyurethane and cyanate ester formulations • Typically used in catalytic and anhydride curing techniques. Amine curing typically requires an upstaging step
	<p>NORYL AP2001G POLYOL Tg: 135°C Mw: 1700 g/mol Improved solubility in MEK</p>	<ul style="list-style-type: none"> • Can improve mechanical and chemical performance in cast urethane formulations when used as a polyol
	<p>NORYL SA9000 RESIN Tg: 135°C Mw: 1700 g/mol Improved solubility in MEK</p>	<ul style="list-style-type: none"> • Bi-functionality and lower molecular weight improves solubility in MEK • Methacrylate functionality helps free radical and UV curing techniques and produces a single-phase system
<p>SPECIALTY DIANHYDRIDE</p> 	<p>BISDA-1000 RESIN Bisphenol A Dianhydride CAS#: 38103-06-9 Melting Point: 180-185°C Purity: minimum 97%</p>	<p>Potential uses include:</p> <ul style="list-style-type: none"> • Polyimide building block may provide improved flexibility, lower moisture uptake compared to commonly used dianhydrides • Epoxy hardener may enable higher Tg thermal performance
	<p>SD1 100P-1000 RESIN Bisphenol A Dianhydride CAS#: 38103-06-9 Melting Point: 180-185°C Purity: minimum 99+%</p>	<ul style="list-style-type: none"> • Polyimide building block where higher purity, in order to achieve higher Mw, is required
<p>SPECIALTY BISPHENOL</p> 	<p>PPPBP-100 3,3-bis(4-hydroxyphenyl)-N-phenylphthalimidine CAS#: 6607-41-6 Melting Point: 293-296°C Purity: minimum 99.8%</p>	<p>Potential uses include:</p> <ul style="list-style-type: none"> • Building block for various thermoset chemistries
<p>SPECIALTY POLYETHERIMIDE</p> 	<p>ER011258 (developmental) Functionalized polyetherimide Tg > 150°C Powder form</p>	<p>Potential uses include:</p> <ul style="list-style-type: none"> • Toughener for composite and adhesive systems • Building block for various thermoset chemistries

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