

• ENVIROCRON® • RAYCRON® •
• CORATHERM® • CORABOND® • CORASEAL® •
• CORACHAR® • CORAGUARD® • POWERCRON® •

Advanced Materials and Coatings for Electric Vehicle Battery Packs



DIELECTRIC PROTECTION

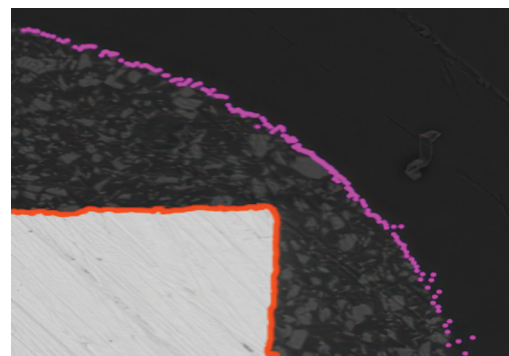
Dielectric coatings systems from PPG deliver performance consistency, durability and enhanced safety with millions of battery components already coated in the last decade. Customers such as OEMs and battery manufacturers use PPG dielectric coatings in place of film and/or tape solutions to eliminate gaps and bubbles, reduce seam failures, increase adhesion for cell-to-pack designs, and support high throughput and automated applications.

The following coatings can be used to insulate battery cells, metal module housings, cooling system components, pack shells, and other critical parts:

ENVIROCRON® Dielectric Powder Coatings

- High-temperature process for metal components, i.e. cooling plates or tubes, unfilled prismatic cells
- Outstanding dielectric performance
- Great thermal conductivity that may enhance pack cooling
- Enhanced edge coverage, allowing for reduced film thickness requirements and for optimized material efficiency
- 100% solids*

* specifically formulated without VOC

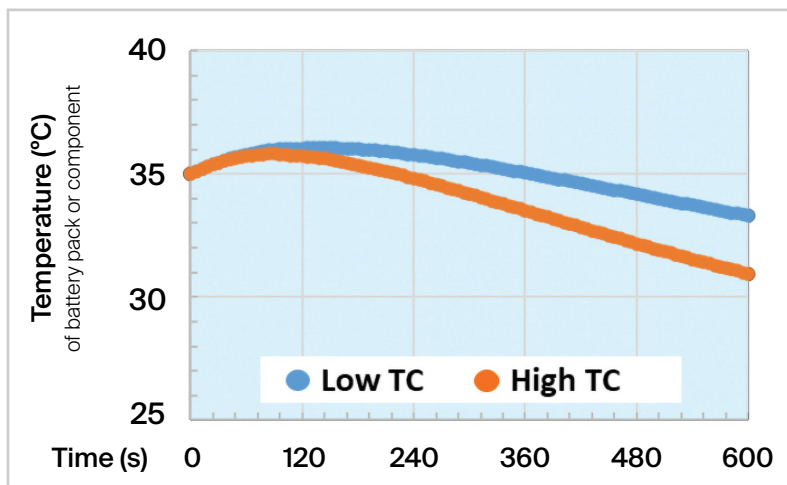


Cross section of increased edge performance powder solution

RAYCRON® UV-Cure Dielectric Coatings

- Low-temperature process for temperature sensitive components, i.e. filled prismatic cell cans, cooling plates, module separators
- 1 - 2 second takt time
- Outstanding dielectric performance
- 100% solids*

* specifically formulated without VOC



PPG Dielectric Portfolio & Its Recommended Applications

End-use	Substrate	Pretreatment	ENVIROCRON® Dielectric PRO	ENVIROCRON® Dielectric BOND	ENVIROCRON® Dielectric THERM	ENVIROCRON® Dielectric EDGE	ENVIROCRON® Dielectric LINK	RAYCRON® Dielectric UV
Battery lid	Alu / Steel	Chemical	o	o	o	★	o	
Battery tray	Alu / Steel	Chemical	o	o	o	★	o	
Frame plates	Alu / Steel	Chemical	o	o	o	★	o	
Module racking	Alu / Steel	Laser / Plasma	o	o	o	★	o	o
Module housing	Alu / Steel	Chemical	o	o	o	★	o	
Cooling plate	Alu / Di-Cast	Chemical	★	o	★	o	★	o
Cooling tube	Alu	Chemical	★		o		★	
Cell (filled)	Alu	Laser / Plasma						★
Cell can (unfilled)	Alu	Chemical	o	★			o	
Busbar	Alu / Copper	Laser / Plasma		o	★	o		

Legend / Notes:

★ Recommended applications o Suitable applications

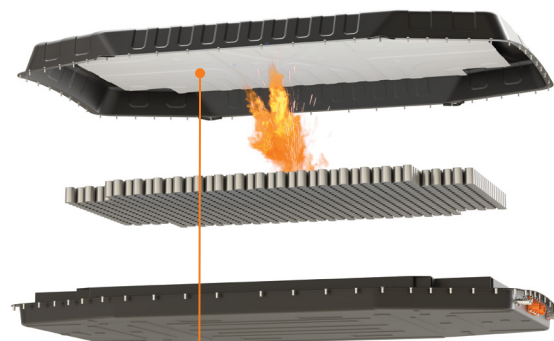
PPG's Fire Protection Coating technologies are designed to support performance requirements across a wide range of applications including battery pack assemblies and energy storage devices.

CORACHAR® and **CORAGUARD®** coatings build on PPG's extensive experience in industrial and commercial fire protection applications. These materials are engineered to support lightweight design and battery pack performance through optimized coating architectures.

Applied to defined substrates, these coatings can help form a protective barrier that supports thermal insulation and heat management behavior, contributing to the mitigation of thermal propagation effects under defined test and application conditions.

In addition, PPG coating solutions are developed to support automated application and integration into high-volume manufacturing environments.

As electrification continues to accelerate across automotive and energy storage industries, scalable and repeatable coating processes are increasingly important. PPG coating technologies are designed to align with these evolving production requirements.



Pack Fire Protection

Coating Solution Supporting Battery Performance

High Heat and Blast Resistance

CORAGUARD® Anti-Blast

- 2K Solvent-free* conformal liquid
- Excellent Mica sheet replacement
- Designed to protect against thermal runaway
- Dielectric protection and protection against corrosion
- High particle resistance
- Electrical insulation properties before and after fire
- UL 2596 and TaG test

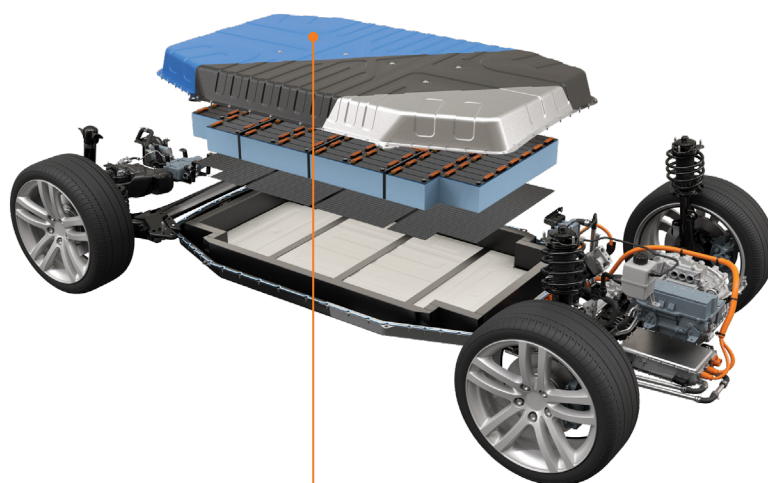
* No intentionally added solvent as supplied. Zero-VOC according to Directive 1999/13/EC, EPA Method 24, EUR Directive: 2004/42/IIA (i) (500)

Thermal Isolation

CORACHAR® and CORAGUARD®

- Solvent-free* conformal liquids
- Intumescent or low intumescent solutions
- Fit for narrow spaces in the battery pack
- Demonstrated fire performance tailorable by needs
- Lightweight solutions
- Supports thermal management and high dielectric isolation

* No intentionally added solvent to Directive 1999/13/EC, EPA Method 24, EUR Directive: 2004/42/IIA (i) (500)



Flame Retardant Powder against ecoat ignition

ENVIROCRON® Flame Retardant Powder and POWERCRON® HD

- Superior corrosion protection with added fire retardance
- Ideal for the battery enclosure
- Applied via automatic or manual device
- Reduced OEM and tier complexity

PPG has developed Powercron® HD, a novel electrocoat technology designed to improve ecoat flame retardancy.

EV Battery packs generate significant heat during operation, which can negatively impact their performance, lifetime, and can drive higher cell temperatures, resulting in accelerated aging and increased risk of thermal runaway. PPG's **CORATHERM®** Thermally Conductive Gap Fillers and Thermally Conductive Adhesives help mitigate these issues by facilitating the transfer of heat away from the cells, allowing for effective dissipation and maintaining optimal operating temperature. Our solutions offer tailorable attributes to meet a wide variety of needs, including thermal conductivity, viscosity, open time and handling strength build-up, adhesion, dielectric protection and fire resistance. These products provide excellent compressibility even with increased open time and maintain performance under harsh operating conditions.

As repairability, repurposing and recycling of batteries become increasingly important, PPG has developed **Debondable Solutions** to enable easy dismantling of battery packs.

CORATHERM® Thermally Conductive Material: Performance Highlights



Silicone-free*

*The product offering is without silicone (not intentionally added)



Low density options for light-weighting



Multiple substrate & total system solution



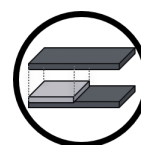
Customizable solutions



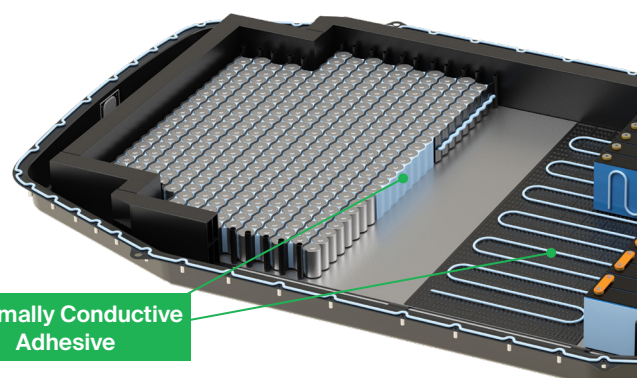
Excellent processability



UL94 V-0



Debonding-on-Demand



Thermally Conductive Adhesive

	CORATHERM® TGF-1000 Series	CORATHERM® TGF-2000 Series	CORATHERM® TCA-4000 Series
Technology	1K Hot Melt	2K Epoxy	2K Polyurethane
Thermal conductivity (W/mK) ASTM D5470	2	1.9 - 2.5	1.2 - 2.5
Density (g/cm³) ASTM D792	1.9 - 2.0	2.0 - 2.5	< 2.2
Mix ratio	NA	1:1	1:1
Open time	Up to 1 week	≤ 1 hour	≤ 1 hour
Application temperature	60 - 70 °C	20 - 35 °C	20 - 35 °C
Compressibility	★★★	★★★	★★★
Structural bonding	NA	NA	★★★
Shock & vibration	★★★	★★★	★★★
Aging performance	★★★	★★★	★★★
Servicability	★★★	★★★	Debonding solutions

Rating:

★ good ★★ very good ★★★ excellent

PPG is a global supplier of adhesives and sealants, combining leading edge science and innovation dedicated to meeting the needs of our customers in their production environment every day. Our latest proven adhesive and sealant technologies are ideally suited to a variety of EV battery pack needs, including sealing of pack shells and components, fixing of cells and modules into packs, structural reinforcement, and impact resistance.

CORABOND® Polyurethane Structural Adhesives

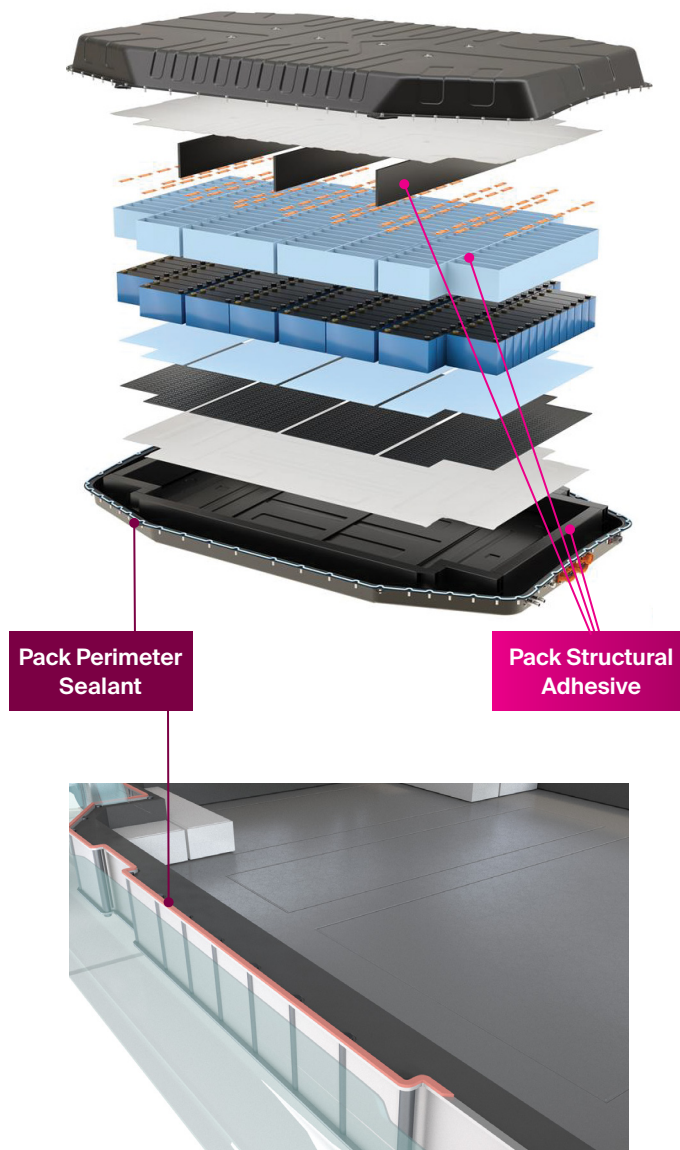
- Excellent mechanical properties with tunable bonding strength
- Good adhesion to multiple substrates
- Low storage modulus for vibration absorption
- Proven application equipment compatibility
- Maintains performance under harsh environmental conditions

CORABOND® Epoxy Structural Adhesives

- Excellent impact strength
- High durability
- Outstanding corrosion and hygrothermal resistance
- Excellent shear strength

CORASEAL® EV Sealants

- Compatible with multiple substrates
- Good compressibility
- Good serviceability
- Fire extinguishing
- Non-expanding, non-reactive



	CORABOND® Structural Adhesives	CORABOND® Flexible Adhesives	CORABOND® Crash Resistant Adhesives
Technology	2K PU	2K PU	2K Epoxy
Mix ratio	1 : 1	1 : 1 / 10 : 1	2 : 1
Open time (min)	5 - 35	4 - 12	45
Lap shear strength (MPa)	≤18 MPa	≥ 4 MPa	≥ 25 MPa
Tensile strength (MPa)	≤18 MPa	≥ 4 MPa	≥ 30 MPa
Application Temperature (°C)	20 - 35 °C	20 - 35 °C	20 - 35 °C
Shock and vibrations	★★★	★★★	★★★
Recommended Applications	Cell-to-Module Module-to-Case	Cell-to-Cell Cell-to-Module	Module-to-Case Case-to-Body

Rating:

★ good ★★ very good ★★★ excellent

CORROSION & IMPACT PROTECTION

PPG offers a comprehensive mix of industry-proven electrocoat, powder coating and polyurea coating solutions for battery shells. Each can be applied through cost-effective, high-volume automated processes. These solutions include:

POWERCRON® Electrocoats

- Ideally suited to metal surfaces
- Uniform film build
- High yield rates
- Highly automated

ENVIROCRON® Extreme Protection Powder Coatings

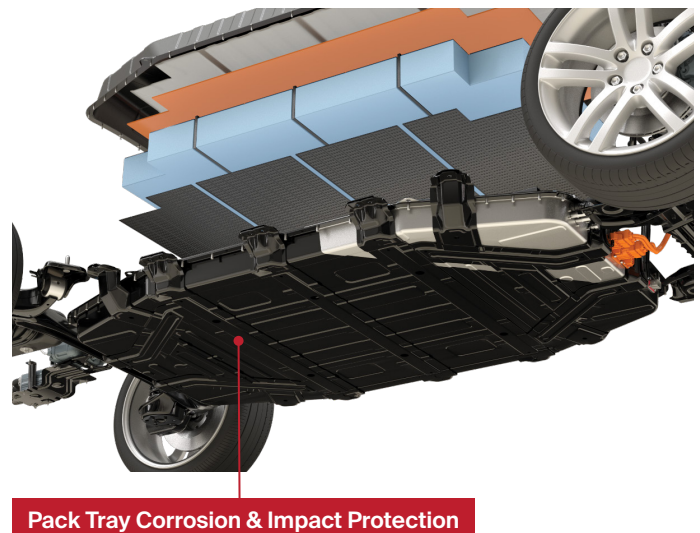
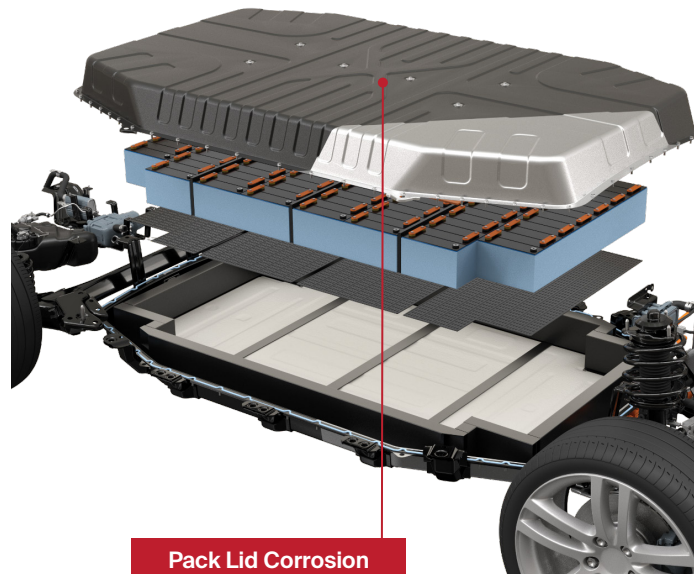
- Combines corrosion and impact protection
- Appropriate for metal battery shells
- Widely used on wear-intensive underbody components

ENVIROCRON® Extreme Protection EDGE Powder Coatings

- All the benefits of ENVIROCRON® Extreme Protection Powder Coating
- Plus protects hard-to-cover sharp edges

Polyurea Coatings

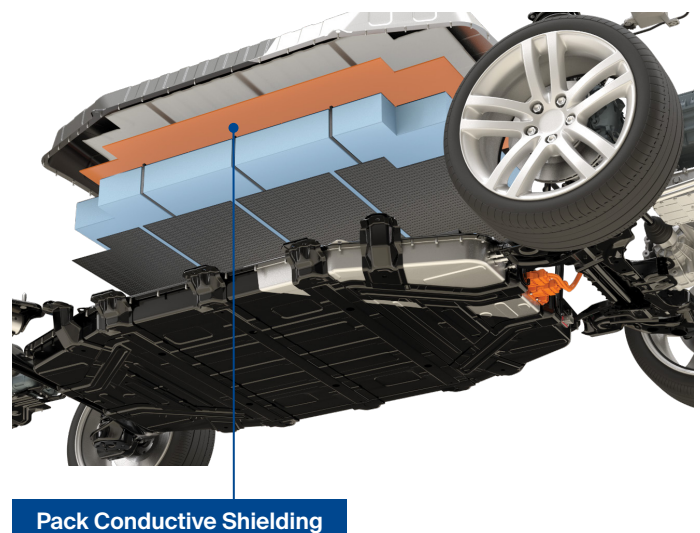
- Formulated to protect shell pack surfaces exposed beneath vehicle
- Outstanding chip and chemical resistance capabilities



EMI/RFI SHIELDING

PPG is a leader in EMI and RFI shielding solutions for the transportation and consumer electronics industries. Shielding applications in electric vehicles include electronic hub cases, HMIs, telemetric systems, ADAS sensors, AV sensor fusion systems, plastic/composite battery enclosures/covers, battery management system cases, and battery chargers and inverters. PPG has both nickel and silver-coated copper sprayable conductive coating solutions which provide:

- Effective shielding in EV applications
- Compatible with sensitive plastics
- Excellent abrasion resistance
- Fast cure





Coatings with a Purpose

With more than 140 years of experience across transportation, aerospace, industrial and consumer electronics markets, PPG combines broad materials expertise with the ability to tailor critical properties for evolving battery design and manufacturing needs.

We support customers by:

- Designing coating technologies to support electrical insulation and thermal management performance
- Leveraging materials developed through extensive research and development of electrical and thermal properties
- Supporting efficient manufacturing through automated application technologies, depending on system design and operating conditions
- Helping optimize cost and throughput by multi-functional coating solutions, depending on application and process conditions

Coatings Services

As a provider of comprehensive EV battery coatings and surface preparation solutions, PPG works with customers worldwide to identify opportunities to support battery performance and durability while helping optimize total system costs, depending on application and operating conditions.

PPG collaborates with customers to tailor coating solutions and support scalable, high-volume application processes with consistent product performance and quality.

Along with protecting and beautifying vehicle components, PPG supports OEMs as well as battery and component manufacturers in advancing next-generation automotive and commercial vehicle energy storage solutions. PPG provides customer-specific battery pack coating solutions, tailored to defined application requirements.

Collaborating with PPG can support the implementation of reliable, high-volume, automated production processes for battery cells, modules, and packs, depending on system configuration and operating conditions. Our automotive coatings experts provide technical on-site support globally, aligned with project requirements.

PPG - supporting the design, construction, and production of battery cells, modules, and packs:

- Dielectric Protection
- Corrosion & Impact Protection
- Fire Protection
- EMI/RFI Shielding
- Thermal Management
- InSite Services
- Adhesives & Sealants

Available services include:

- Design and construction of application equipment
- Process optimization and technical troubleshooting
- End-to-end coating operations management and support



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We protect and
beautify the world®

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