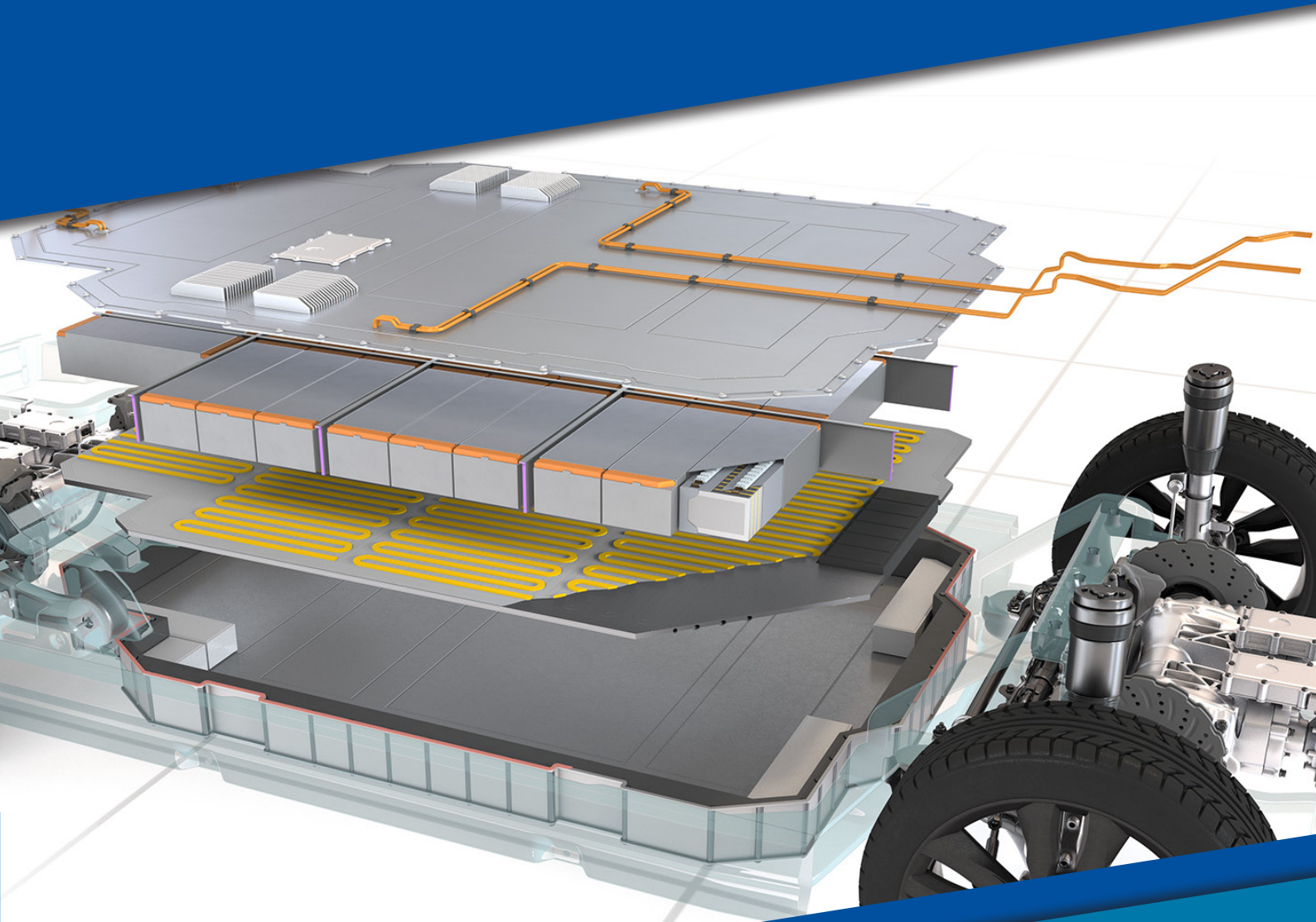


# EV Battery Pack Materials Solutions

Improved Performance | Supported Safety | Automated Applications | Reduced Costs



We protect and  
beautify the world™

# Coatings With a Purpose

Our broad-based materials expertise and ability to tailor critical properties – developed over 137 years of leadership in the transportation, aerospace, industrial and consumer electronics industries – touches virtually every area of battery design and construction.

## We help customers:

- Improve electrical and thermal safety using PPG's proven coating technologies
- Deliver safety through proven research and development on electrical and thermal properties
- Automated application technologies allow cost effective manufacturing
- Reduce manufacturing cost and increase throughput using PPG multi-function coating solutions

Along with protecting and beautifying these vehicles, PPG is helping OEMs and battery and component manufacturers accelerate the development of tomorrow's automotive and commercial vehicle energy storage solutions. PPG delivers innovative and customer specific lithium-ion battery pack solutions.

Collaborating with a global leader like PPG can help you successfully implement reliable, high-volume, automated production of battery cells, modules and packs. Our automotive coatings service experts can provide skilled on-site support at any time, in any location.

## PPG – delivering solutions for the design, construction and production of Li-ion battery cells, modules and packs.

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



ENHANCED BATTERY  
PERFORMANCE



IMPROVED  
BATTERY SAFETY



AUTOMATED  
APPLICATIONS



REDUCED  
BATTERY COST

## Coatings Services

As a provider of comprehensive EV battery coatings and surface preparation solutions, PPG works with customers around the world to identify opportunities to enhance battery performance, durability and safety while reducing total system cost. In addition to identifying and customizing coatings solutions to specific application requirements, PPG partners with customers to ensure successful, high-volume application and exceptional product consistency and quality.

### Available services include:

- Application equipment design and construction
- Process optimization and troubleshooting
- End-to-end coatings operation management





## DIELECTRIC PROTECTION

Dielectric coating systems from PPG deliver performance consistency, durability and enhance safety. Customers such as OEMs and battery manufacturers use PPG dielectric coatings in place of film and/or tape solutions to eliminate gaps, bubbles, reduce seam failures, enhance edge protection, and to support high throughput and automated application.

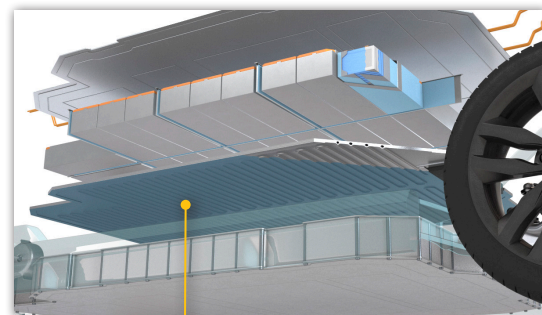
The following coatings can be used to insulate battery cells, metal module housings, pack shells, cooling system components and bus bars and connectors:

### ENVIROCRON® Extreme Protection Dielectric Powder Coating

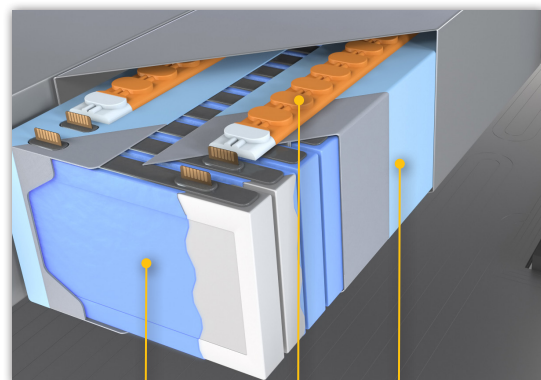
- High-temperature process for metal components (cooling plates, prismatic cells [unfilled], and bus bars and connectors)
- Outstanding dielectric performance (2 coats)
- 100% solids, solvent-free\*

### RAYCRON® UV-Cure Dielectric Coating

- Low-temperature process for temperature sensitive components (prismatic cell cans [filled] / module separators)
- 1-2 minutes takt time
- Outstanding dielectric performance (2 coats)
- 100% Solids, solvent-free\*, sprayable liquid



Cooling Plate/Tube Dielectric



Cell Can Dielectric Protection

Bus Bar Dielectric Protection

Cell Holder Dielectric Protection

## FIRE PROTECTION

PPG's CoraChar™ solutions provide safety and performance standards for a wide range of applications, including battery pack assemblies and energy storage devices. The coatings, which leverage PPG's proven experience with both industrial and commercial fire protection, improve light-weighting, increase battery performance, and support passenger and first-responder safety in case of a thermal event.

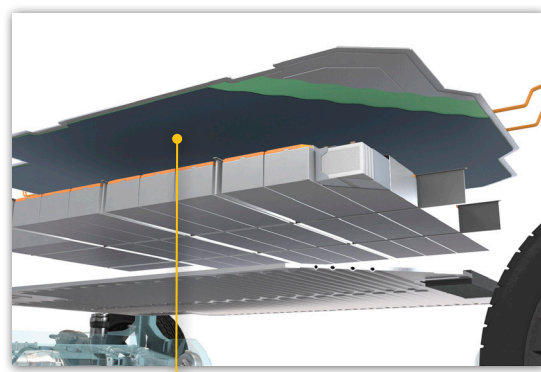
PPG's battery fire protection coatings provide a shield to the substrate, helping to contain and minimize thermal events. These solutions are ideal for electric vehicles and battery pack assemblies. They can meet the increasing fire safety regulations and can accommodate specific customer technical and application requirements through consultative product selection and coating thickness optimization, including temperature and burn rate. PPG's CoraChar™ solutions continue to build upon PPG's strong legacy as a trusted technology as a high-quality coating provider.

### CORACHAR™

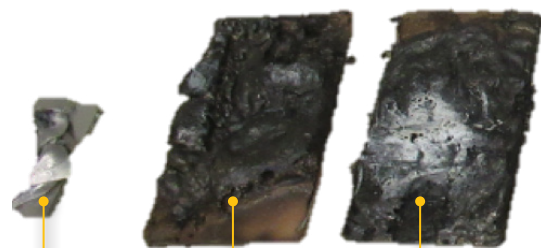
- Intumescent fire protection technology
- 2 component solvent-free\* conformal liquid
- Resistant to chemicals and moisture adsorption
- Thin when inactive, low density when activated
- Responsive thermal characteristics
- Demonstrated fire performance tailorable by needs
- Lightweight
- Supports thermal management and dielectric isolation

#### Application

- High throughput robotic spray process, automated for mass production
- Battery pack assemblies (BEV, PHEV, BESS)
- Energy storage components (including for pressurized hydrogen)
- Potential substrates include: aluminum alloy, steel and composite components



Pack Fire Protection



Uncoated

Coated with PPG Battery Fire Protection

\*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 MANAGEMENT

PPG coating solutions can support and enhance all Battery Thermal Management System (BTMS) strategies. Common solutions and applications include gap filler/ thermal conductive adhesive and dielectric thermal conductive coatings between battery plates and modules, and thermal conductivity coatings between cooling coils and plates. Our solutions offer tailorable attributes: thermal conductivity, abrasion mitigation, weight (low density), electrical conductivity, viscosity, vibration damping, applied cost, and adhesion. These solutions include:

### CORATHERM® Thermal Gap Filler

#### Product/Formulation

- Low hardness
- 1K and 2K silicone-free options
- Low-density
- Low-press-in force for fast battery assembly and conformability
- Design for serviceability
- Adjustable electrical insulation properties
- Flame resistant (fire mitigation)

#### Application

- High throughput, low defect application, lower abrasion
- Between cells, cells and module housing, cell and cooling plate, module and cooling plate

### CORATHERM® Resilient Foams

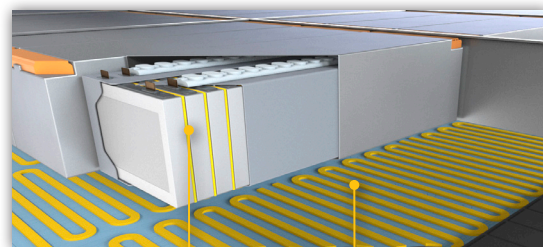
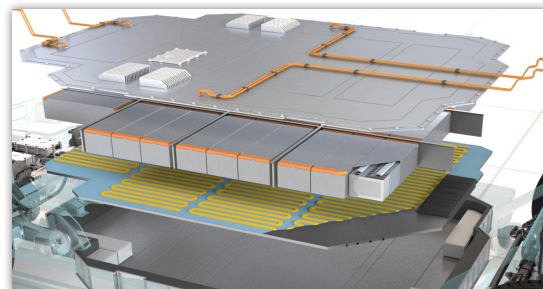
#### Product/Formulation

- Foam-in-place or pre-formed pads and parts
- High resilience, rebound after compression
- Thermal insulation
- Flame resistance
- Silicone-free
- Low-density
- Ambient cure
- Compatible with mass production tact times
- Adjustable electrical insulation properties (dielectric isolation)

## EMI/RFI SHIELDING

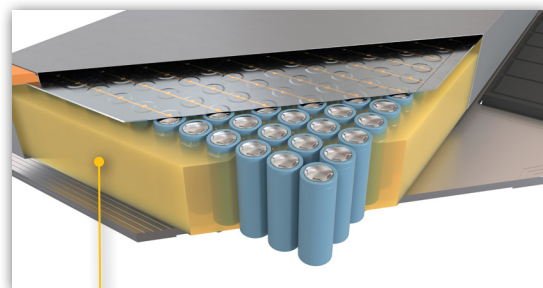
PPG is a leader in EMI and RFI shielding solutions for the transportation and consumer electronics industries. Shielding applications in electric vehicles include electronic hub cases, HMIs, telemetric systems, ADAS sensors, AV sensor fusion systems, plastic / composite battery enclosures / covers, battery 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
- Passes U.L. requirements
- Excellent abrasion resistance
- Fast drying



Module Thermal Adhesive

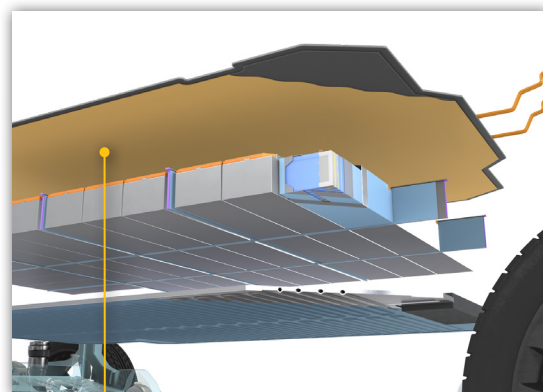
Cooling Plate Thermal Gap Filler



Foam-in-place

#### Application

- Prevent fire propagation of thermal runaway
- Maintain temperature in battery pack



Pack Conductive Shielding

## CORROSION & IMPACT PROTECTION

PPG offers a comprehensive mix of industry-proven electrocoat, powder coating and polyurea coating solutions for Li-ion 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 EDGE Powder Coating

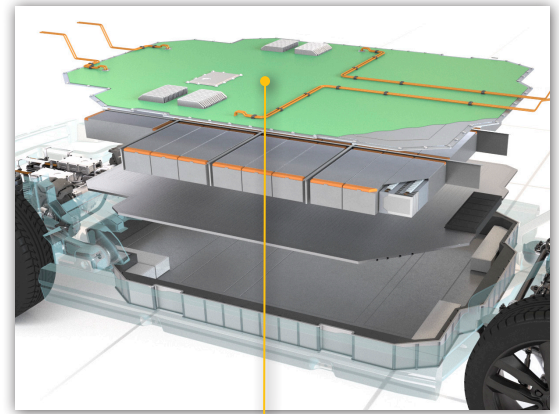
- Protects hard-to-cover sharp edges

### ENVIROCRON® Extreme Protection Powder Coating

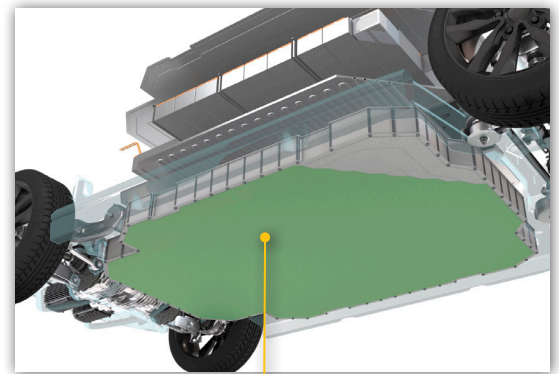
- Combines corrosion and impact protection
- Zinc primer / proprietary topcoat system
- Appropriate for metal battery shells
- Widely used on wear-intensive underbody components

### Polyurea Coatings

- Formulated to protect shell pack surfaces exposed beneath vehicle



Pack Lid Corrosion



Pack Tray Corrosion & Impact Protection

## ADHESIVES & SEALANTS

PPG's 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. Solutions include:

### CORABOND® Epoxy Structural Adhesives

- Superb shear strength
- Excellent wash-off resistance
- High durability
- Outstanding corrosion and hygrothermic resistance
- Excellent impact peel strength

### CORASEAL® Sealants

#### CORASEAL® RT400

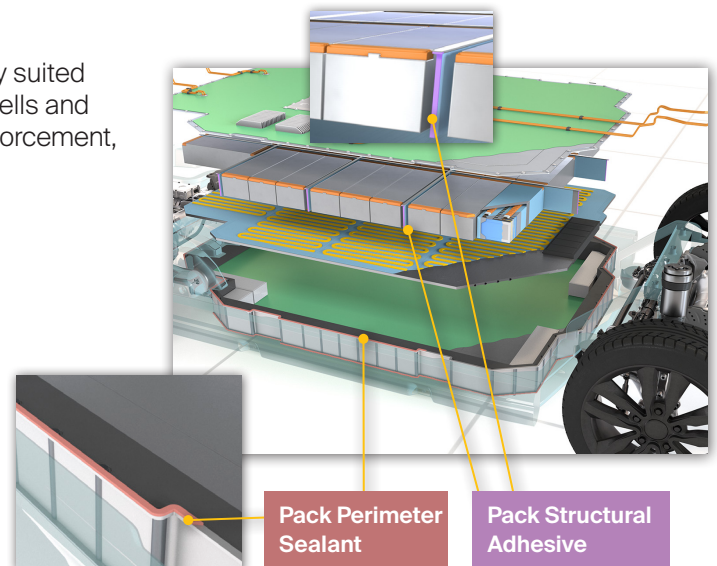
- One-component sealer
- Rubber-based technology
- Applied in OEM body shop
- Excellent wash resistance
- Non-tacky surface

#### CORASEAL® 2940

- One-component sealer
- Excellent wash resistance
- Non-expanding
- Accepts welding
- Corrosion resistant

#### CORASEAL® EV 2025

- Peripheral sealer function
- Applied in assembly shop
- 1K hot-melt, black
- Fire extinguished, good serviceability
- Good compressibility, tightness





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