Driving EV performance and passenger safety

Industry challenges & DuPont solutions

Frank V. Billotto | Feb. 2022

DUPONT™

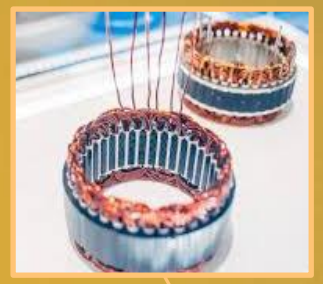
Global Footprint to Meet Customer Needs

DuPont Automotive

Examples of Products and Applications

Belt & Hose Reinforcement
Kevlar® in tires
Nomex®/Vamac® in turbo hoses

Starter & Alternators Insulation
Zytel® PA, Crastin® PBT in insulation parts, connectors, frames
Nomex® in stator

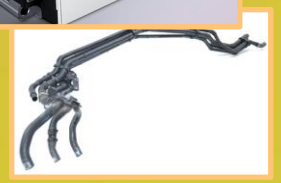


E-Motor Solutions
Nomex® & Kapton® in e-motors
Zytel® PPA and Crastin® PBT for bus bar rings, sensors and HV connectors
Temprion® for wide bandgap chipset inverter power electronics

Structural Adhesives
BETAMATE™ &
BETAFORCE™
BETASEAL™ Glass Bonding

Friction Material
Kevlar® for clutch & brake pad materials

Tires
Kevlar® reinforcement

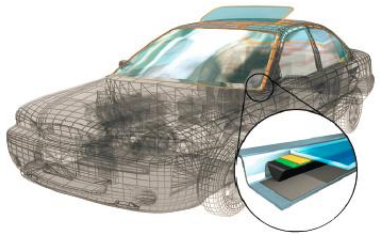


xEV Thermal Management
Thermal management & battery assembly solutions
Zytel® PA for frames, end plates
Zytel® LCPA cooling pipes and connectors
Kapton® for EV PTC heaters
Kevlar® MicroCore™ battery separator technology
Vespel® for battery insulation

DUPONT™

DuPont Mobility & Materials
Adhesives and Battery Solutions

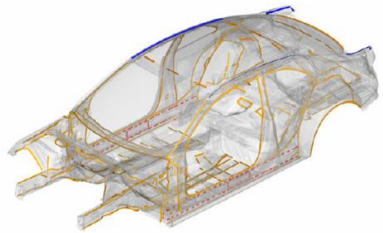
GLASS BONDING



BETASEAL™
PU Technology
1K & 2K
Elastic sealants
Primerless Adhesives

BETAPRIME™ & BETASEAL™
Primers

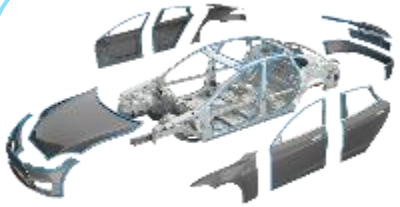
BODY



BETAMATE™
Epoxy Technology
1K & 2K
Structural Adhesives

Multi-material Bonding
Expandable Adhesives
Low Temperature Cure
Wash-off Resistance

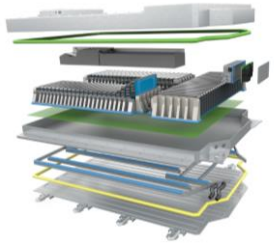
MIXED MATERIAL BONDING



BETAFORCE™
PU Technology
1K & 2K
Structural Adhesives

Multi-material Bonding
Modular Assembly

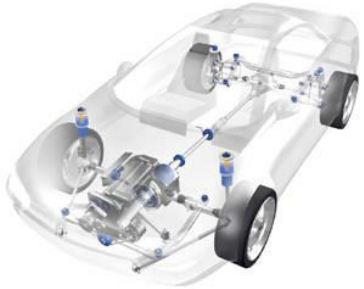
BATTERY



BETAFORCE™ and BETAMATE™ TC
Epoxy & PU Technology
1K & 2K
Structural Adhesives
Thermally Conductive Adhesives

BETATECH™
Thermal Interface Materials

ANTI-VIBRATION



MEGUM™ THIXON™
Cl, Br polymers
Siloxane Seal Adhesives
Single Coat
Primers + Cover Cements

W-series waterborne AVS

Thermal Adhesives for Battery Pack Assembly

EDISON AWARDS

Key Application Needs

Broad range of applications, most involving direct adhesion to battery cells

- **Thermal management** without sacrificing bonding performance
- **Solutions ranging from elastic to highly rigid**
- **Solutions with low abrasion and excellent** electronic properties

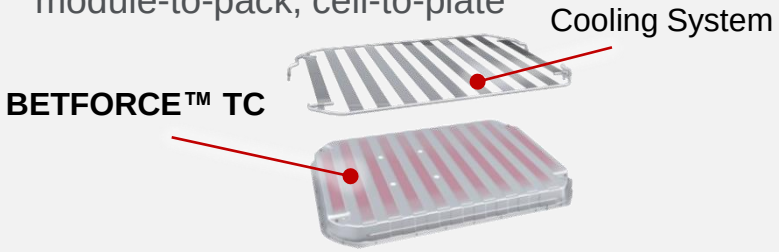
Key Development Challenges

- High thermal conductivity with robust adhesion
- Materials with varying mechanical performance
- Broad range on mechanical & processing properties

Shear Strength: 3 – 7 MPa → 10 – 20 MPa → 15 – 25 MPa

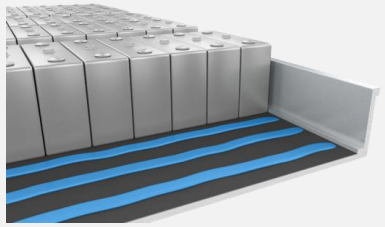
BETAFORCE™ TC

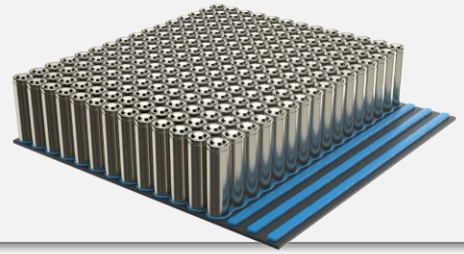
- Thermal conductivity: 1.0 – 3.0 W/m·K
- Good bonding to treated Al and composites
- Long open time for large application areas
- Heat acceleration for rapid assembly
- Applications: cell-to-cell, cell-to-pack, module-to-pack, cell-to-plate



BETAMATE™ TC 2K Acrylic

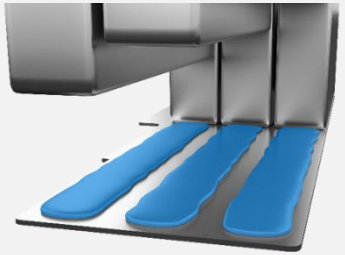
- Thermal conductivity: 1.0 – 1.5 W/m·K
- Very rapid assembly, no heat acceleration
- Good adhesion to metals & plastics, often without pretreatment
- Applications: cell-to-plate, cell-to-pack





BETAMATE™ TC 2K Epoxy

- Thermal conductivity: 1.0 – 1.5 W/m·K
- Excellent adhesion to metals & composites
- Long open time & fast heat cure acceleration
- Dielectric strength: >30 kV/mm
- Applications: module to pack, cell-to-pack



DUPONT™

BETATECH™ Thermal Interface Materials – using new innovative chemistry devoid of silicones

Technology Needs

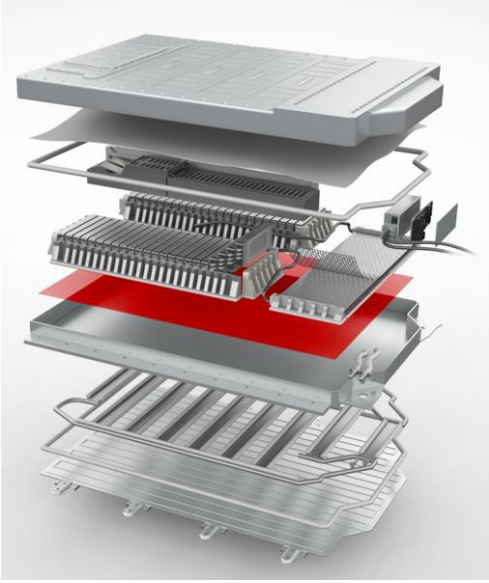
Thermal connection of cells to cooling system

- **High thermal conductivity**
- **Low viscosity** – low press-in force for efficient process
- **Repairability:** non-destructively remove single cells

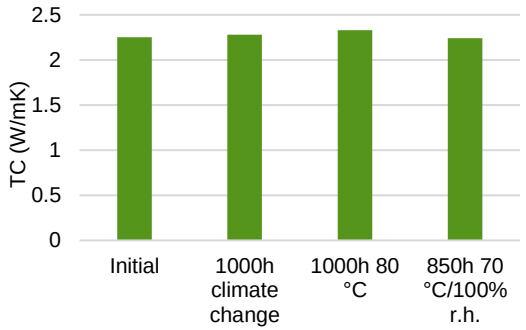
Key Products

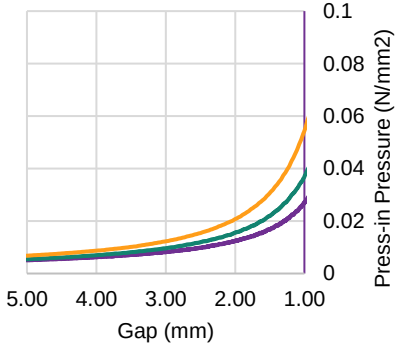
- BETATECH™ – 1K PU, 2 W/mK – ease of application
- BETATECH™ – 2K PU, 2 W/mK – lowest viscosity
- BETATECH™– 2K PU, 3.5 W/mK – high TC, low viscosity

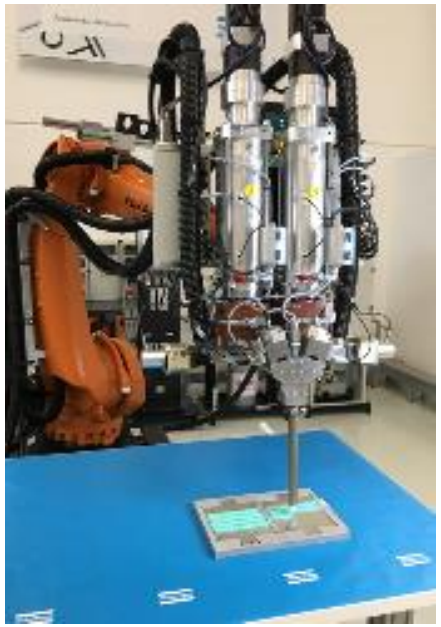
Our Solution

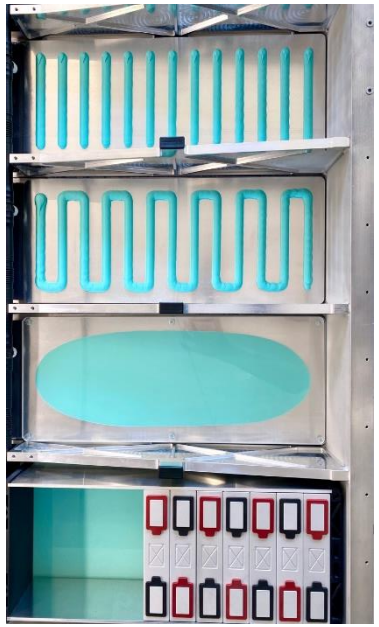


- **Proprietary polymer technology** combined with engineered filler package offers low viscosity, low density, high TC formulations
- **Robust performance over aging**
- **Low pull-out** for non-destructive repair solution
- **Free of silicone** thermal interface materials



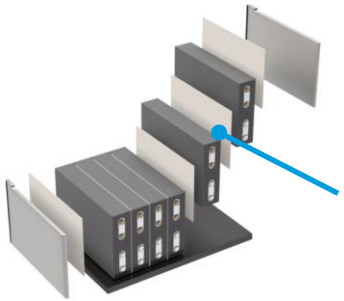






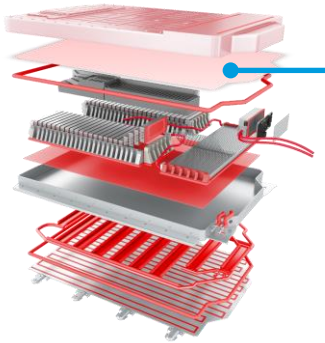
A single source for safer EV batteries

DuPont offers packaged solutions using Nomex® to help OEMs design safer EV batteries using a system approach and by collaborating with leading battery manufacturers and auto OEMs to address the increasing challenges.



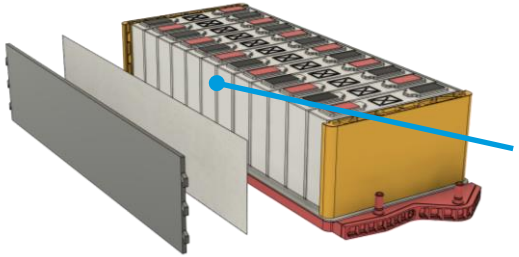
Between cell thermal barrier:

Nomex® CellShield™



Battery enclosure flame protection:

Nomex® SafePak™



Electrical insulation:

Nomex® 410, Nomex® 818

Between cell thermal barrier solution

Mitigate thermal propagation between cells

Battery enclosure flame protection solution

Helps prevent fire penetration through battery enclosure

Battery pack electrical insulation

Inherently flame-retardant electrical insulation