



*A collaborative approach
to future mobility*



Our journey to three: creating world leading companies

2017

We brought together the complementary, innovative portfolios and pipelines of Dow and DuPont



>200 years of cumulative partnership with the Global Automotive Industry



2019

With the intent to create three strong, independent companies

April



Materials Science

June



Agriculture

June



Specialty Products

**We empower the world
with essential innovations
to thrive...by discovering and
delivering results that matter**

At a glance: Transportation & Industrial



\$5.62bn

2018 net sales

~5,700

Colleagues

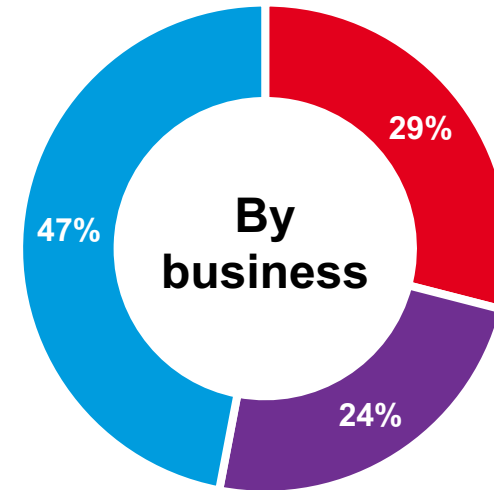
39

Manufacturing
sites

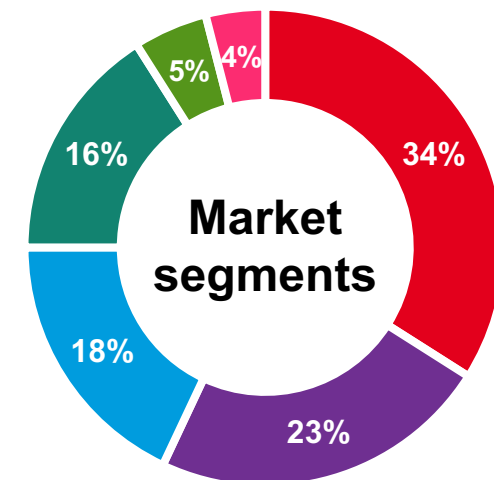
Transforming industries and improving lives through
material science



Net sales (2018):



- Engineering Polymers
- Performance Resins
- Performance Solutions



- Automotive
- Future Mobility
- Electronics
- Industrial
- Healthcare
- Consumer

Global Footprint to Meet Customer Needs

AHEAD™ Technical and innovation Centers



Autonomous driving
Radar transparency
Virtual reality

REV.ENG.E-LAB -> Collaboration with A2MAC1
Thermal management Rig
Connectors overmolding tool
Tomograph
Vertical press for large housings
Virtual reality
Thermal conductivity through plane tester

REV.ENG.E-LAB -> Collaboration with A2MAC1
EMI Shielding
Lamination units for KV/Nomex
Battery Fire testing

Introducing AHEAD™

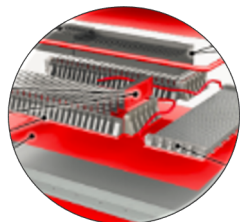
Accelerating Hybrid-Electric Autonomous Driving

DuPont's AHEAD™ initiative will provide a single source for varied applications in vehicle **electrification, autonomy, connectivity and supporting infrastructure space.**

- Supported by expertise in materials science and electronics
- Reinforced by long industry experience
- Leveraging broad, differentiated portfolio of technology and solutions



AHEAD Focus Areas



Battery Module

Bus bar electric insulation
Thermal barrier pads
Structural 2K PU assembly
Dispensable thermal conductive
Gap filler
Sealants
Bus bar holder
HV connectors
Module end plate

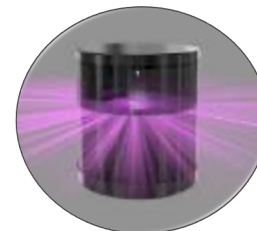
Kapton®	Nomex®
BETAFORCE™	BETAMATE™
BETASEAL™	Zytel®
Zytel® HTN	Crastin®
Kevlar®	



PE & E Motors

Terminal connector
Bus bar module
Electric current sensor
OBC
E-Axle pinion thrust washer
E motor hybrid bobbin
E motor slot/wire insulation
Control board/PCB
Compound semiconductors

Zytel®/Zytel® HTN	Nomex®
Crastin®	Kapton®
Rynite®	Vespel®
Temprion®	SiC



Signal Electronics

Sensors (Touch)
Radars / Lidars
Cameras
Antenna
Semiconductor
Electronic Control Units
Heaters

Zytel®	GreenTape®
Zytel® HTN	InMold Electronics
Crastin®	Intexar®
Kapton®	



Infrastructure

Transformer insulation
Charging connectors & plugs
Wire & Cable
V2X
Surface Protection

Nomex®
Zytel®
Zytel® HTN
VAMAC®
Tedlar®

Industry challenges



Thermal management: Higher energy-density batteries; small, powerful e-motors and ultra-fast charging create thermal management challenges in safety and efficiency.



Safety: Thermal/electrical safety of EV drivetrains combine with passenger and pedestrian safety standards requiring integration of active and passive safety systems.



NVH: Ride experience is more important than ever as autonomous vehicles become work and social environments.



Charging Infrastructure: Networks of fast-charging infrastructure will be integral to the proliferation of electric vehicles. Durable, upgradeable and user-friendly charge points will be necessary.



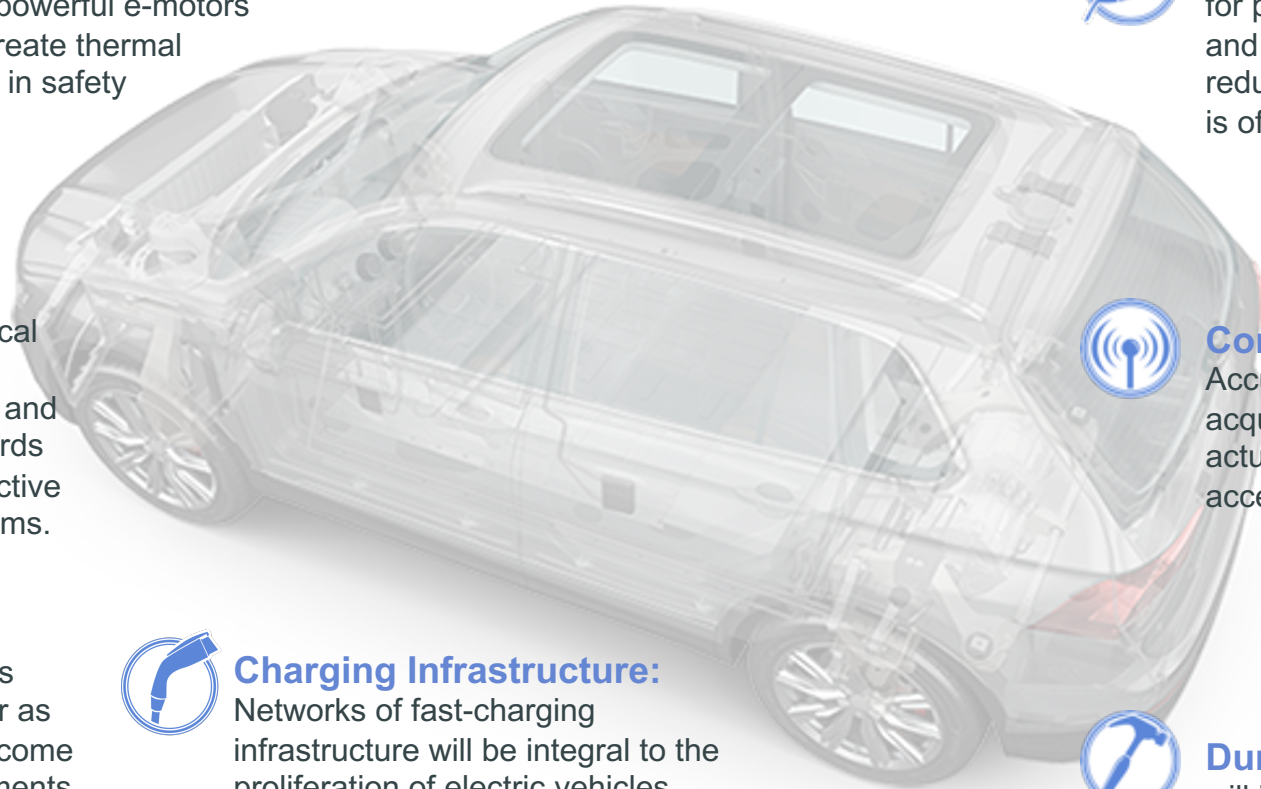
Lightweighting: Driven by consumer desire for parity between the driving range of electric and fossil-fueled vehicles, further weight reduction in EV chassis, drivetrain and batteries is of paramount importance.



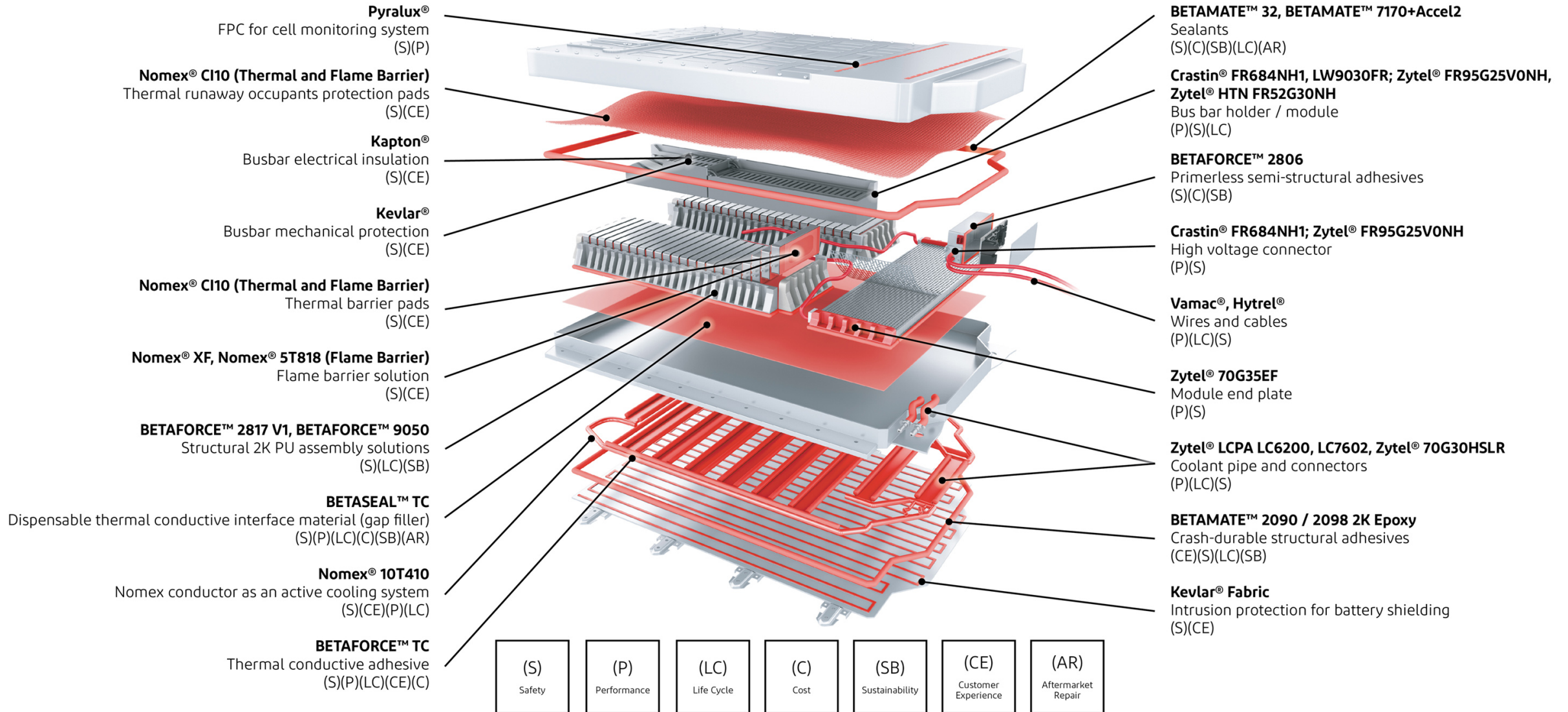
Connectivity, sensing and control: Accurate, upgradeable and reliable data acquisition systems and electro-mechanical actuators will dictate powertrain electrification acceptance as well as autonomous driving.



Durability: Autonomy and car/ride sharing will increase life cycle expectations for future vehicles, requiring improvements in durability for chassis, electronic and interior components.



Battery : our materials at a glance



Battery Pack : Thermal management

Thermal Conductance

Dispensable Thermal Interface Material (TIM)

BETASEAL™ TC

(S)(P)(LC)(C)(SB)(AR)

High thermal conductivity, vibration dampening, low press-in & pull-out force and high dispensing flow,...

Applications example: In manufacturing process dispensable *Thermal Interface* paste between battery module & heatsink

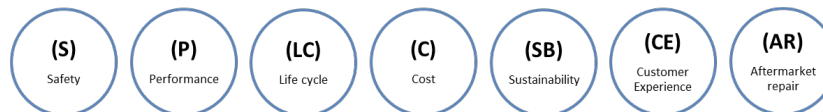
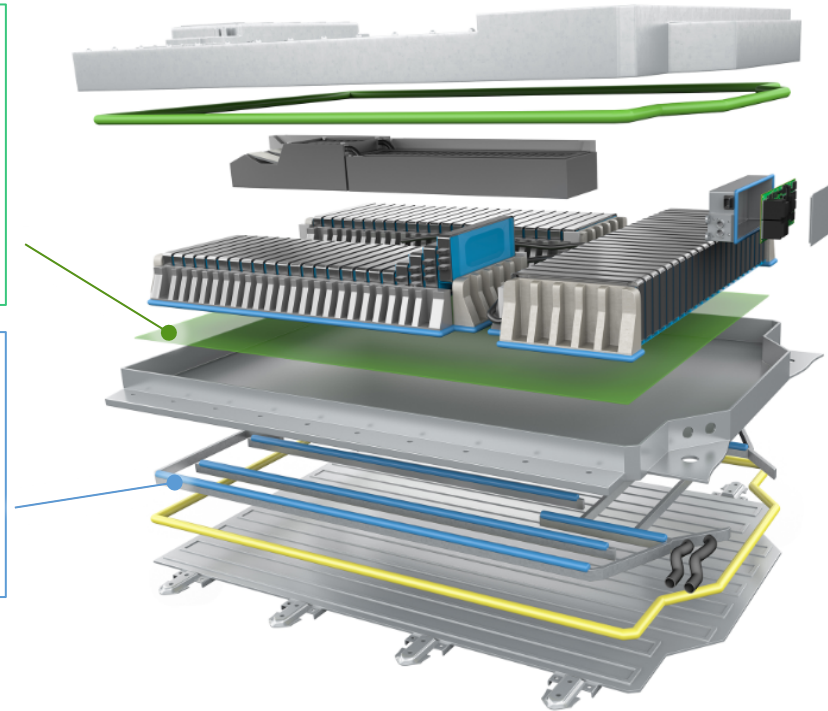
Thermal Conductive Adhesive:

(S)(P)(LC)(CE)(C)

BETAFORCE™ TC

Thermal Conductive adhesives solution, Heat cure accelerate able, high elongation, vibration inhibitor.

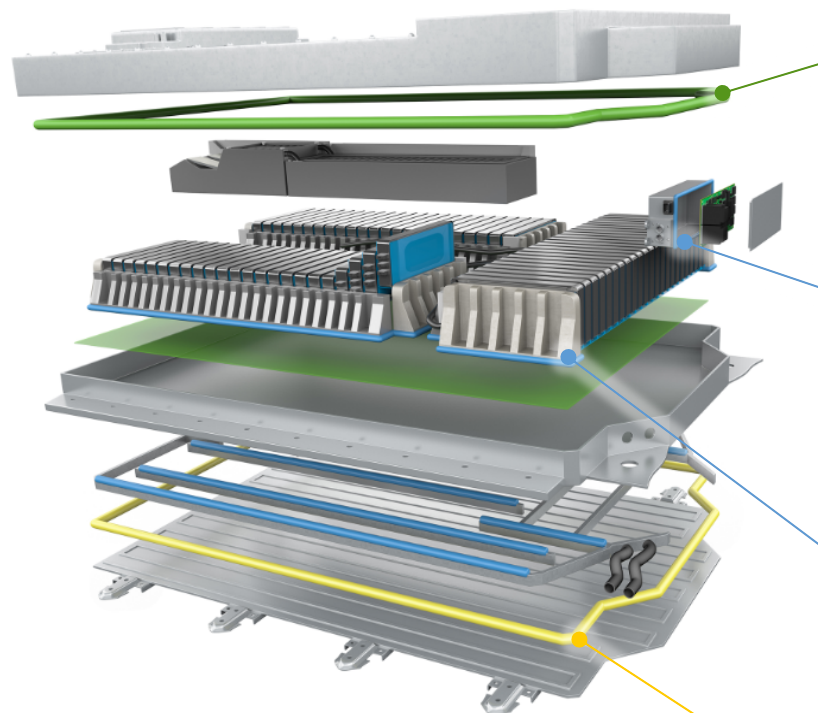
Applications example: Bonding cooling unit to heat sink



Battery Pack : Assembly Solutions

Protection

Reliability



Battery Case Assembly

Sealant:

(S)(C)(SB)(LC)(AR)

BETAMATE™, BETASEAL™

Primerless to: eCoated metal, bare aluminium
Dielectrical, Fire resistant, Repairable

Applications example: Battery lid bonding

Semi structural adhesive:

(S)(C)(SB)

BETAMATE™ 2810 , BETAFORCE™ 2806 - Primerless

High elongation, enabling multi substrate assembly of
light & economical substrates, vibration inhibitor

Applications example: Semi structural assembly of
module cases & Control Units (plastic to metal)

Structural 2K PU assembly solutions:

(S)(LC)(SB)

BETAPRIME™1707 + BETAFORCE™2817 V1, BETAFORCE™9050

Best in class balance between elongation and
structural performance for multi substrate bonding

Applications example: Battery Frame Bonding

Crash Durable Structural adhesive:

(CE)(S)(LC)(SB)

2K Epoxy BETAMATE™

Adhesion on bare aluminum, Glycol resistance

Applications example: Battery compartment crash
integrity applications

(S)

Safety

(P)

Performance

(LC)

Life cycle

(C)

Cost

(SB)

Sustainability

(CE)

Customer
Experience

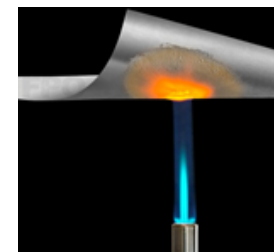
(AR)

Aftermarket
repair

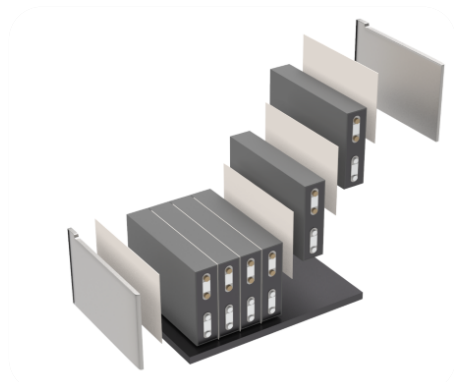
Battery : Thermal Safety

Advanced solutions proven in ballistics and aerospace

Problems to solve : Thermal runaway, internal/external fire



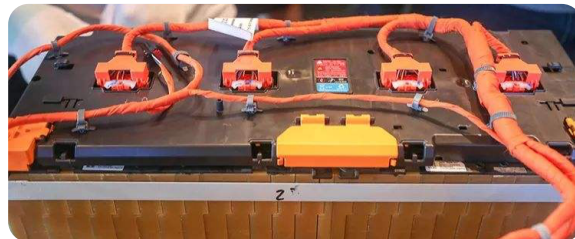
Flame Protection



*Cell to Cell Insulation
Nomex® CI10*



*Module to Module Insulation
Nomex® CI10*



*Flame Barrier – Parts Protection
Nomex® XF30*



*Flame Protection – Top Lid
In Development*

Thermal Insulation

- ✓ Nomex® CI10

Applications

- Cell to cell thermal insulator to mitigate thermal propagation
- Module/pack level thermal protection

Flame Barrier

- ✓ Nomex® XF30
- ✓ Nomex® Mica Paper

Applications

- Prevent internal fire propagation to outside of battery enclosure
- Protect key parts (eg. Bus bar, BMS, Terminals, Cable) against direct flame

Electrical Insulation

- ✓ Nomex® Mica Paper
- ✓ Nomex® Pressboard

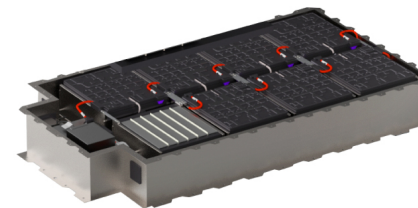
Applications

- Electrical insulation between cell, module side plate, or other critical parts such as Bus bar, BMS

Battery : Mechanical Safety

Advanced solutions proven in ballistics and aerospace

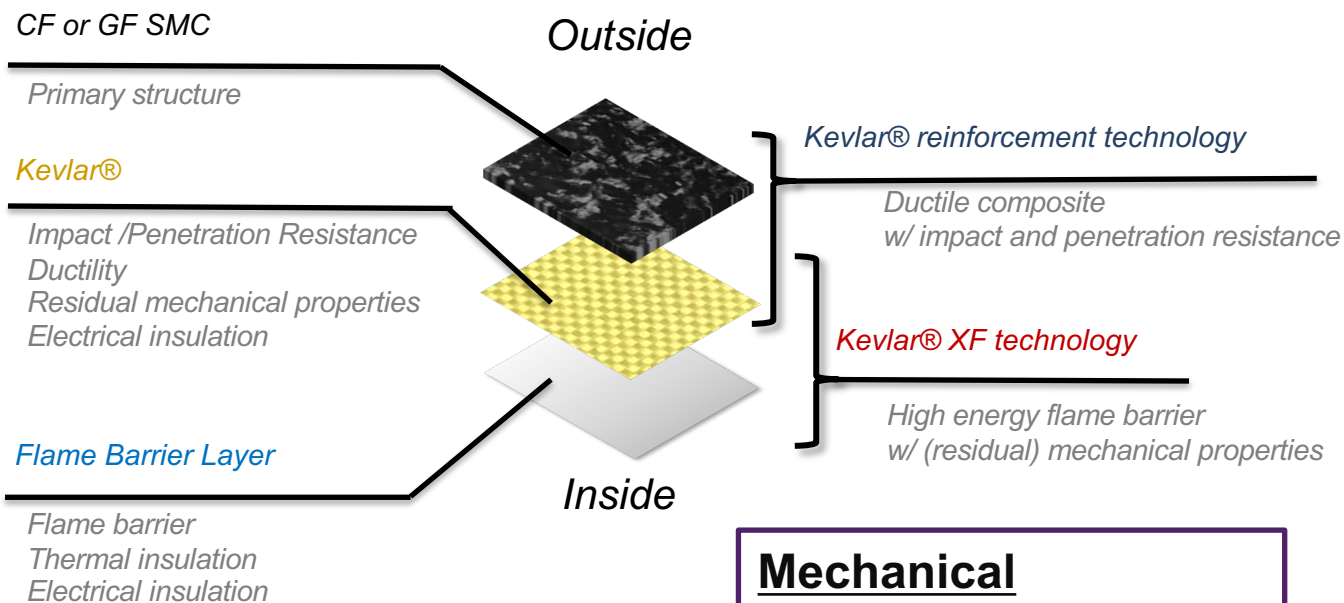
Problems to solve : debris intrusion, crash protection



Enclosure Materials



Multi-Material Solution



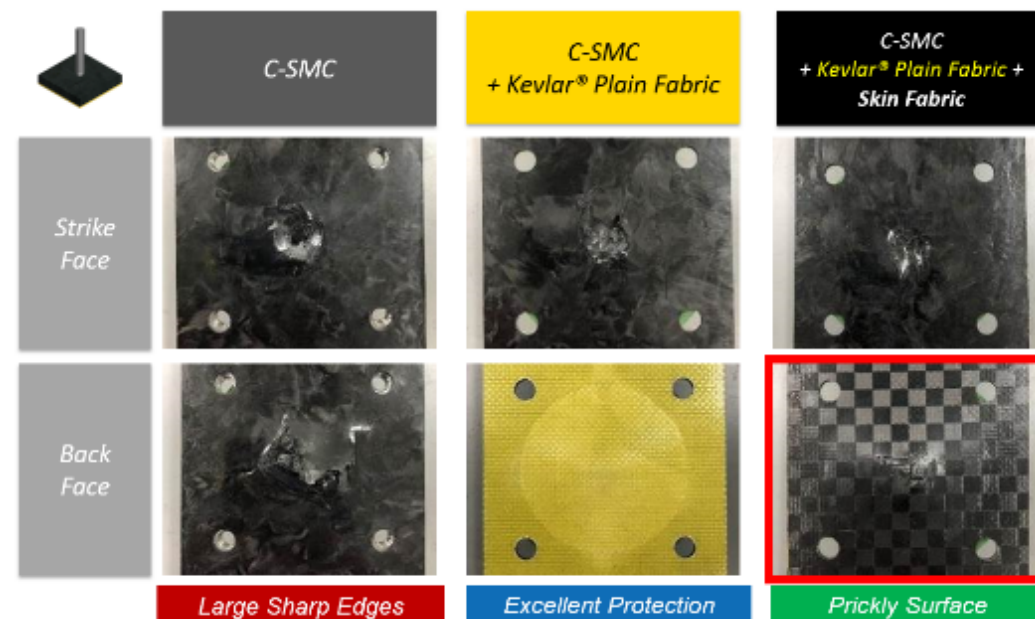
Mechanical Protection

✓ Kevlar® Fabric

Applications

- Protect key parts from mechanical damage (eg. Bus bar, Terminal, BMS, Battery enclosure)

Impact Behavior



Renault Sport Racing and DuPont Announce Strategic Partnership

Advanced Technologies for Higher performance

- › Multi-year technical partnership to advance Formula 1 and other racing programs
- › To extend the developed technologies to consumer and road-car applications (hybrid and electric powertrain solutions)
- › Focus includes structural adhesives for thermal management of batteries, and materials for power, infrastructure and signal electronics





Copyright © 2018 DuPont and Dow. All rights reserved. The DuPont Oval Logo and DuPont™ are trademarks of E. I. du Pont de Nemours and Company or its affiliates. The Dow Diamond Logo, Dow™ are trademarks of the Dow Chemical Company or its affiliates.

Nothing contained herein shall be construed as a representation that any recommendations, use or resale of the product or process described herein is permitted and complies with the rules or regulations of any countries, regions, localities, etc., or does not infringe upon patents or other intellectual property rights of third parties.

The information provided herein is based on data DuPont believes to be reliable, to the best of its knowledge and is provided at the request of and without charge to our customers. Accordingly, DuPont does not guarantee or warrant such information and assumes no liability for its use. If this product literature is translated, the original English version will control and DuPont hereby disclaims responsibility for any errors caused by translation. This document is subject to change without further notice.