Fact Sheet

DuPont Automotive Materials and Technology for Vehicle Electrification
Charging the Future of Electric-Powered Vehicles

Essential DuPont products for safer, lighter, more efficient energy storage options for hybrid electric (HEV), plug-in hybrid electric (PHEV) and electric vehicles (EV):

- High-Performance Engineering Polymers, such as Zytel® HTN PPA, Vespel® Parts and Shapes, Crastin® PBT and Zenite® LCP for heating & cooling systems, pumps and impellers, electrical connectors, power boxes and wire & cable systems as well as structural housings and battery components and supports
- High-Performance Fluoropolymer resins as binders for capacitors and lithium ion batteries
- DuPont Teijin Films (PET and PEN) separators for dry capacitors
- DuPont Hybrid Membrane Technology using a nanofiber in nonwoven form as a developmental product for separators for Lithium Ion Battery and other energy storage devices

Fundamental challenges facing electric-powered vehicles ….

… Mass, Space and Packaging

The additional weight of power electronics, electric motors and battery packs in HEVs is negating some of the fuel and CO2 savings inherent in the technology. And while the weight-savings-to-fuel-economy ratio for HEVs *is less* than it is for internal combustion engine vehicles (ICEs), carrying an extra 400 lbs. (200kg) still increases fuel consumption by 1.2 miles per gallon (0.41/100km).* Fuel consumption also increases as power increases.

- Plastics, with up to 40% lower mass than aluminum, deliver critical weight savings but also provide design flexibility to enable parts integration and improve packaging to save space and cost.
- Opportunities for high-performance plastics include: Prismatic cell frames with cooling channels: pumps and heat exchangers for thermal management; connectors, control modules, power distribution and DC-DC inverter (Insulated Gate Bipolar Transistor) boxes, traction motor magnet encapsulation, housings and magnet wire insulation.
- Characteristics of high-performance plastics range from heat, warp and creep resistance for critical housing and encapsulation applications; chemical resistance and low-moisture pickup in cooling and fluid flow applications; and electrical insulation and flame retardants to meet the high-voltage requirements.

*Source: "How Hybrid-electric vehicles are different from conventional vehicles: the effect of weight and power on fuel consumption," by C. Reynolds and M. Kandliker, 2007

… Power and Performance

The goal is to increase power and energy density and to capture wasted energy for increased range, greater speeds, longer life and to enable smaller, multi-functional devices.

- In super-capacitors that store and provide balanced energy requirements, DuPont has seen up to a 40% improvement in device life with proper design. Thinner, higher temperature films can enable smaller, more powerful super-capacitors with broader application temperature capabilities, while reducing production times.
- In Lithium Ion Batteries, high temperature and performance cell separators have demonstrated a significant improvement in power delivery, electrolyte wetting and potential for substantial safety improvement.
- Using higher-performance materials in cell separators reduces wasted energy due to low resistance to ion transfer with otherwise good barrier properties, delivers longer device life from chemical and thermal stability and produces higher energy output due to a thinner, denser separator membrane that uses nano-technology.

… Electrical Insulation

Advanced EV/HEV battery packs and power delivery systems require protection from exposure to high-voltage systems.

- Many DuPont Engineering Polymer materials, such as Crastin® PBT, Zytel® HTN and Zenite® LCP are USCAR approved for high-voltage systems and some offer tracking indices up to 600 volts.
- DuPont™ Vespel® Parts & Shapes offer excellent thermal and insulating properties, as they have no melt point or Tg, making them suitable for applications in electric powertrains where other polymers won't survive.
- DuPont insulating coatings, paper and film (Voltron® wire enamels, Voltatex® varnishes, Nomex® aramid paper and Kapton® insulation tape), provide customers a unique offering in products, electric traction motor insulation design and testing capability unsurpassed in the electrical insulation industry. This uniquely positions DuPont to meet performance and reliability for electronic controls and for magnet wire in electric motors.

… Heating and Cooling Management Systems

Most battery systems operate within a range of 40°C to 60°C, but higher temperature electronic control modules and battery temperature safety margins of -20°C to 140°C make heat transfer critical for performance. Many component and system designs include channels for coolant, automatic transmission fluid or dielectric fluid to transfer heat.

- Plastics offer several advantages over aluminum in terms of lower mass, more design freedom (plastics can be molded into complex shapes to enable parts integration) to help resolve critical space and packaging challenges.
- High-performance characteristics include long-term resistance to ethylene glycol and moisture pick-up and overall broad temperature range to ensure optimal performance.

… Safety

The run for higher power and energy density is challenging the upper performance limits of some materials. New materials and technologies with greater stability and added heat and flame resistance have been newly launched or are in development.

- Several new electrically friendly Zytel® HTN PPA 54 series resins have been developed with tracking indices above 600 volts to help prevent electrical arcs and potentially dangerous sparks in connectors.

… Cost

DuPont's focus is to help enable future energy solutions that are economically sustainable, striving to manage/reduce costs through several strategies:

- Global technical development teams to help identify and capitalize on the 30% to 40% cost savings typical in metal-to-plastic conversions
- More productive/higher output processing techniques, especially via new material developments for improved mold flow, thinner-wall parts and gas-assist molding with inner-part cellular structures

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