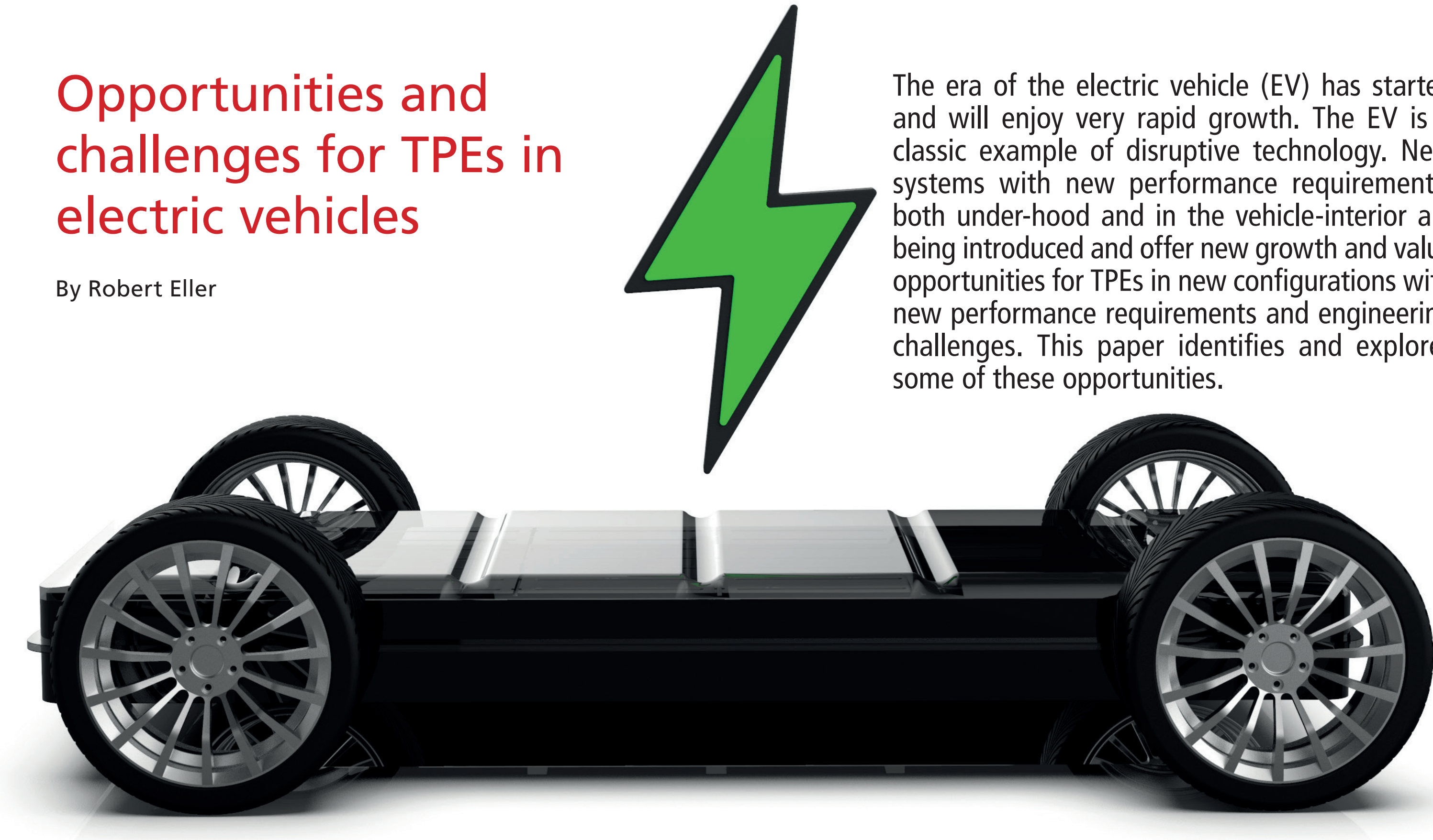
Opportunities and challenges for TPEs in electric vehicles

By Robert Eller

The era of the electric vehicle (EV) has started and will enjoy very rapid growth. The EV is a classic example of disruptive technology. New systems with new performance requirements, both under-hood and in the vehicle-interior are being introduced and offer new growth and value opportunities for TPEs in new configurations with new performance requirements and engineering challenges. This paper identifies and explores some of these opportunities.



Source: EDOYO – stock.adobe.com

TPE challenge evolution

When looking at the potential role for TPEs in EVs and how these challenges are evolving, it is useful to view the TPE evolution as first generation (Gen 1) and second (Gen 2) generation as TPE properties evolve to meet the demands of the EV evolution as illustrated in table 1.

TPEs competing

In the EV space must meet a broader range of properties than first generation TPEs. The challenges are related to thermal, shielding (especially EMI), fire resistance (FR)adhesion, chemical resistance, and dimensional stability requirements.

TPE opportunities associated with heating and cooling

Pre-eminent among these new challenges and associated opportunities are those related to heating and cooling the battery cells(modules). Figure 1 shows an example battery, casing and cooling configuration. The pathways to use of battery heat

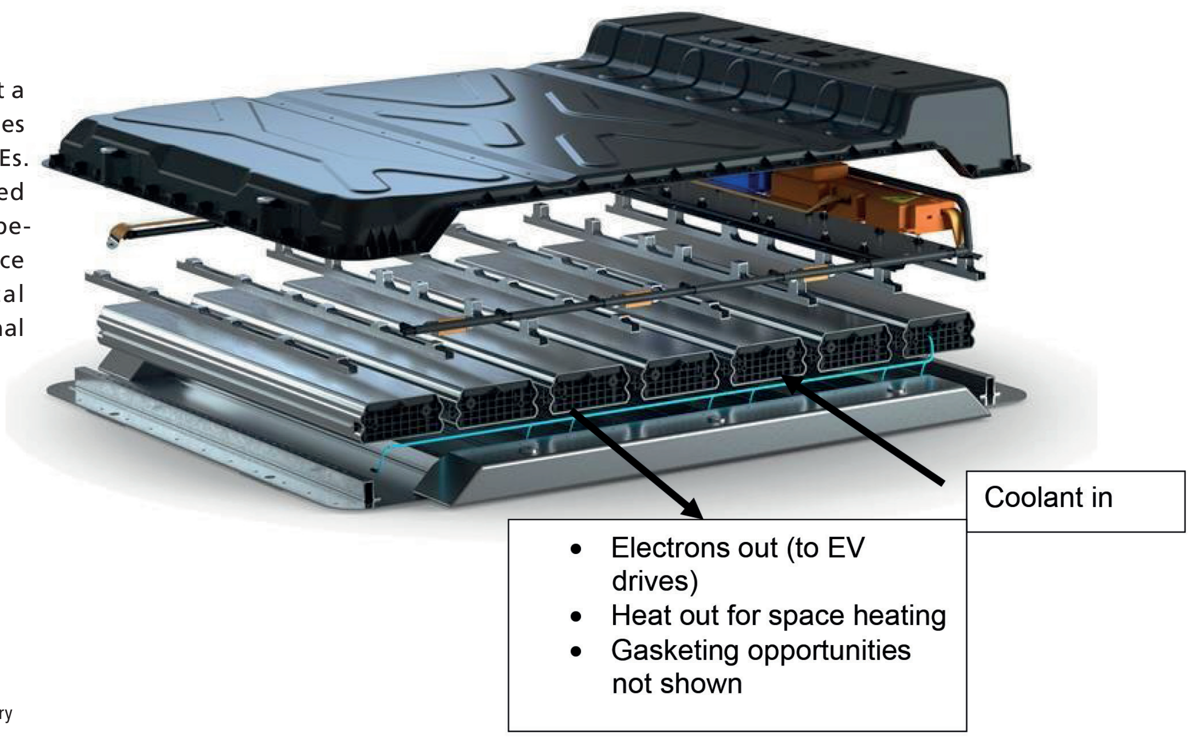


Fig. 1:
Example of EV battery casing with battery cells cooling and heating

Source: Fraunhofer Institute(sketch), Inputs/outputs (REA) for heating passenger zone and gasketing are not shown for clarity. The battery cells must be protected from overheating, for example during charging and from freezing in cold weather situations. Systems typically target keeping battery cells within the 20-40 °C and the temperature range difference between cells within 5 °C in order to avoid capacity degradation, thermal runaway or fire hazard. This presents opportunities for high temperature TPEs at various locations within the battery casing and in the battery proximity.

Tab. 1: The evolution of the TPE properties for EV and AV applications

Property	Gen.	Note / Status
Adhesion to ETPs	1	Already well developed but new requirements have evolved
Bio-based	2+	Starting
Conductivity	2+	Starting in seal applications
Chemical resistance	1+	Starting. Will be important in battery cell gasketing. Role in battery coolant resistance (see fig. 1)
Elasticity, low compression set, resilience, etc	1	These are first generation properties for which upgrades are needed.
EMI shielding	1+	Will become important for autonomous vehicles (AVs) and other applications operating in signal rich applications
Electrical properties	1+	Gaining importance in high voltage applications, (see note (a) below)
Foamable	1	Difficult, not impossible with o-TPVs
Fire resistance, dissipation	2+	Needed for battery proximity applications, grades are being introduced
Heat resistance/ dissipation	1+	Starting, will be important in battery-related applications
Recyclate content	2	Starting
Heat resistance	2+	Needed for battery proximity applications
Smart	2+	Smart TPEs starting
Sustainability		Starting

Notes
(a) CTI-Comparative tracking index
RTI- Relative thermal index (max service temperature)
Dielectric properties
Dissipation factor-also called Q quality factor

Future vision

EVs will penetrate the global automotive market to a substantial degree resulting in the opportunities that were identified in table 1. The challenges and opportunities that will be encountered are identified in table 2. TPEs in automotive will grow along with EV penetration but the era of drop-in replacement in existing applications is over.

The new TPE applications that can ride the boom will have a broadened set of properties to accommodate the new thermal, electrical, fire resistance challenges in the opportunity zones.

The automotive supply chain will evolve along with these changes as compounders learn how to provide FR, high value attributes such as electrical properties, signal management (both sending and receiving), bonding to a new generation of ETPs. The automotive TPE supply chain will evolve along with these improvements.

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All figures and tables, unless otherwise stated, have been kindly provided by the author.

Tab. 2: EV challenges and opportunities for TPEs

Challenge	TPE opportunity	Note
Charging-How to do it rapidly, safely, cost effectively	Swap-out (a), FR grades High temperature grades	Improved TPE grades being introduced
Interior configuration changes	New interior designs especially in AVs	EV front end creates new space management opportunities for interiors
No engine noise	Front end noisemaker	Road noise still requires acoustic management
Electronic noise in the interior	EMI management TPE grades	Protections against signal interference
Heating passenger compartment via battery heat	Hoses and gaskets	Via standard configurations

(a)Swap out especially well-suited for fleet operations