

WHY USE POLYMERS?

A third of the roughly 30,000 parts in cars are made of plastics of which 70% are Polyamide (PA), Polypropylene (PP), polyurethane (PU), and polyvinyl chloride (PVC). The prime motivation for increased use of automotive polymers is that they offer enormous freedom in the design of interior and exterior parts, and they are durable, have good haptic properties, and are abrasion- and vibration-resistant. Moreover, they are easier to process and offer an improved price to performance ratio.

Additionally, plastics are lighter than conventional materials, which may help to improve fuel efficiency and could reduce the carbon footprint of a car. Together with good recyclability, plastics therefore play a part in meeting present and future sustainability targets.

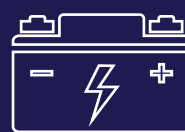
Below we have listed some of the key areas where polymers are used in cars.



POLYMERS IN POWERTRAIN APPLICATIONS

BATTERY

Polymers like polyvinylidene fluoride (PVDF), acrylics, polyethylene (PE), polyethylene glycol (PEG), polyimide (PI) fulfil some of the key characteristics required in batteries such as high adhesion, high electrolyte absorption, chemical resistance, and high thermal stability. These types of polymers are used in battery binders and separators. Likewise, polyphenylene ether (PPE), polypropylene (PP), polyethylene (PE), polyvinyl chloride (PVC) are used in the battery module, including for cell frames, retainers and battery pack top covers giving them hydrolytic stability, long-term dimensional stability, low specific gravity, and chemical resistance to acids, as well as good impact resistance.



POWER TRANSMISSION

The power transmission system in an electric vehicle (EVs) helps to convert electrical energy into mechanical energy. It mainly consists of motors, actuators, seals, gears and the steering system. Polyphthalamide (PPA), polyether sulphone (PESU) and long glass-reinforced PPA have increasingly found their way into these components. Other important engineering plastics, like ultraform polyoxymethylene (POM) are used to produce actuators which are used in several assemblies, such as seat control, automatic light control, or

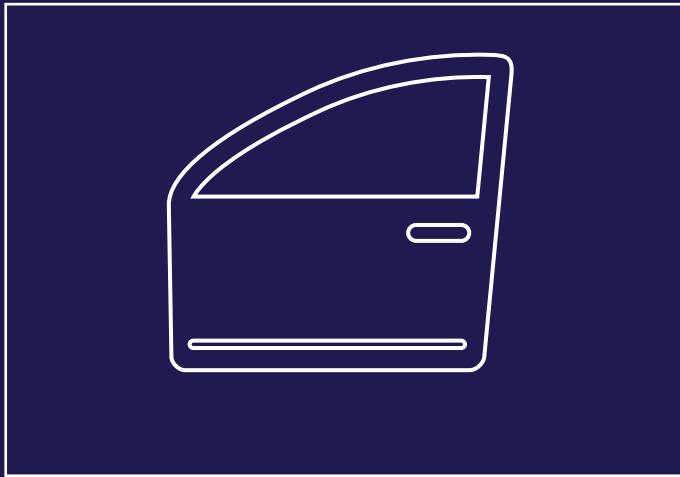
door locks. PTFE is a commonly used material for sealing as it offers lower friction and good heat resistance. Metal gears are not only costlier but also generate high noise levels during operation. These gears were previously made from metals, but they are now replaced by plastics due to their reliability, and the simplicity of designing and manufacturing. Commonly used plastic materials for gears are polyamides (PA), polyether ether ketone (PEEK), Fluoropolymers like PTFE, ABS, high-density polyethylene (HDPE), and POM.



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POLYMERS IN INTERIOR APPLICATIONS

Nylon and polyester are best suited for car interiors because of their high strength to weight ratio and ease of designing features, resulting in stylish, comfortable, scratch-resistant, and long-lasting interior components. One can find these polymers in the door panels, roof liner, pillar trims, console, parcel shelf in the back, floor carpet, IRVM, AC system, seat belt and cup holders. Nylon and polyester fabric are also a popular choice for upholstery applications including carpets, seat covers, seat backs, head rests, arm rests, seat bases, seat tracks, sun visors, trunk liners, roof liners and dashboard upholstery.



POLYMERS IN EXTERIOR APPLICATIONS

The use of plastic in car exterior parts enhances the durability and lowers the overall weight of the vehicle, thereby boosting the driving range with each re-charge of an EV.

The polymer used in making bumpers is a polycarbonate and polybutylene terephthalate (PC/PBT) blend. Amorphous PC material provides toughness, while semi crystalline PBT provides enhanced thermal stability and chemical resistance.

Synthetic rubber synthesised from polymers found in crude oil is used to manufacture robust tires and synthetic polymers like ethylene propylene diene monomer (EPDM) are used for windshield applications as they perform better than natural rubber in terms of thermal ageing, ozone, tearing, and UV resistance.

Polymers are also used in hybrid vehicles' fuel tanks, where they are made of high-density polyethylene (HDPE) that is fluorinated to keep volatiles in the tank and avoid gaseous leakages.

POLYMERS IN COMFORT AND SAFETY APPLICATIONS

LIGHTING SYSTEMS

Headlights are increasingly made of polycarbonate (PC) due to excellent light transmission, high temperature stability, easy processability while being less expensive and more durable compared to glass which is brittle and has low impact resistance. PC provides both the required functional and aesthetic aspects with its expanded scope of design versus glass. Headlamp reflectors and headlamp bezels are made of polyether sulfone (PESU) due to its high dimensional stability under heat and excellent surface quality.

Plastics used in the lighting system not only improve customer comfort and safety, but also provide a higher level of visual branding in the vehicle's interior and exterior. The various applications include colour-changing LEDs in footwells, front and rear cupholders, and heating, ventilation, and air-conditioning. Polymethyl methacrylate (PMMA) is a highly sort after material for these applications.

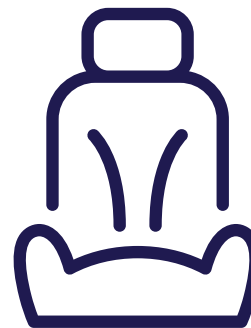
CHARGING CONNECTOR

Thermoplastic materials such as PA 6, PA11, PBT, and PC, with glass reinforcement, are used for EV charging connectors. The safety of electrical and fire systems can be improved by the addition of flame retardants. However, the incorporation of additives increases the cost along with a decrease in the mechanical performance of the composite material, and hence a balance of both is necessary.

“Compounded Annual Growth Rate of Global Market for Polymers in EVs (2020-2026): 38.7%”

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Ref: Gupta, Prashant, et al. "Recent developments and research avenues for polymers in electric vehicles." The Chemical Record 22.11 (2022): e202200186

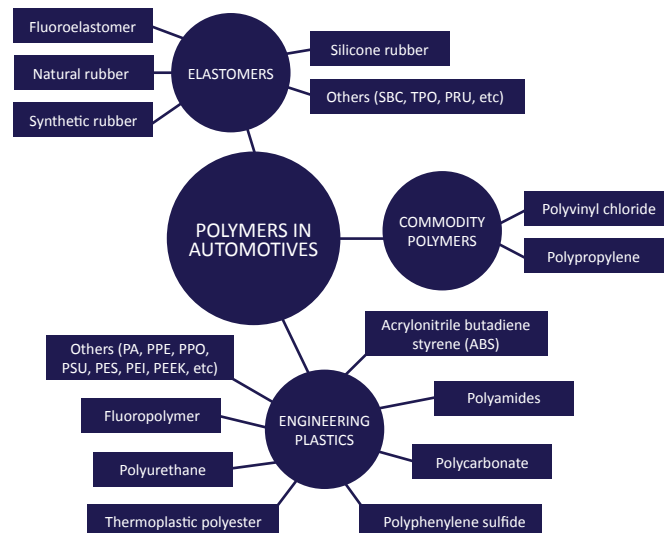


SENSORS

The use of PTFE and PEEK polymer shields, or radome, and connectors is of extreme importance as they are neutral towards the signals transmitted and received by the sensors.

WIRING AND CABLES

PTFE and polyimide (PI) are notable polymers used in electrical insulation. They minimize leakage of current, which in turn improves the battery life and allows an EV or a hybrid car to cover more distance on a single charge.



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