# Innovations in Plastic Body Panels

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With new technologies for vertical and horizontal automotive body panels, GE Advanced Materials has started a strategic offensive that stands clearly out against the existing polymer solutions in this application area. Key advantages include significantly higher modulus, lower coefficient of thermal expansion and extended design freedom for highly integrated and weight saving parts with "class A" paintable surface quality.

In the 1990s, engineering thermoplastics such as Xenoy* PC/polyester and Noryl* PA/PPE blends were key to weight, fuel and cost saving automotive exterior applications. In the meantime, however, the established polymer technologies, as implemented with particular consistency in the case of the Smart car, are bordering on their limits. Automotive manufacturers are asking for polymers with a fit not just for self-colored and clear or offline base coated body parts of relatively confined dimensions, but also for larger panels up to complex, three-dimensional units with properties no longer met by conventional plastics.

Main requirement include:

- First: Considerable more design freedom for integration of parts, functions and manufacturing steps – not to forget pedestrian impact protection, all of which is clearly exceeding the issue of styling while it can build on the toughness of many engineering plastics. In addition, increased integration at lower part weight requires higher stiffness and modulus.
- Second: Flash gap reduction for enhanced aesthetics as well as reduced mechanical provisions in the manufacturing and painting processes. At a typical coefficient of 9 to 10 x $10^{-5}$ mm/mm/°C, current flash gaps with engineering thermoplastics have a width of 5 to 6 mm, which is considered too much for a higher quality appearance.
- Third: Improved planarity, reduced post-shrinkage and less warpage – in other words: better dimensional stability. Otherwise, particularly horizontal components, such as engine hoods or roof modules with "class A" surface quality, can hardly be realized in series production.
- Fourth: On-line and off-line paintability with environmentally sound water-borne paint systems.

In taking up these challenges, GE Advanced Materials has developed two innovative material technologies that provide clearly higher performance properties at significant weight savings: **HMD**, for **h**igh **m**odulus and **d**uctility, and **HPPC**, for **H**igh **P**erformance Thermo**p**lastic **C**omposites.

### Higher Modulus, Lower Coefficient of Thermal Expansion

HMD is based on a proprietary nano-filler technology that leaves existing thermoplastics for automotive body panels far behind. Most obviously, perhaps, it offers an enormous potential for reducing the coefficient of thermal expansion to values below 5 x $10^{-5}$ mm/mm/°C while at the same time exhibiting less anisotropic behavior – for correspondingly smaller flash gaps unthinkable with standard polymer technology.

Furthermore, at densities only negligibly above than those of their unfilled base polymers, HMD materials feature stiffnesses that can double or triple the standard. The achievable modulus is at 4,000 to 5,000 MPa, complemented by high ductility. This opens a wide potential for integrations for an automotive body design consolidated in form and function – with benefits from material integrity and greater ease of assembly to economic recycling.

Moreover, HMD technology also meets advanced processing requirements for injection molding. Material flow is clearly superior to that of mineral filled polymers, and there is almost zero post-shrinkage.

**Advanced Technology for Large-Surface Horizontal Body Components**

Complementary to the three HMD polymer platforms, GE Advanced Materials is also developing high-performance thermoplastic glass fiber composites (HPPC). These materials are focused on large-surface horizontal body parts, such as engine hoods and roof modules as well as their substructures. As an ideal processing method, the vacuum forming technique for these applications is currently being optimized in cooperation with partners from the plastics machinery and mold manufacturing industry.

HPPC technology is based on Xenoy* PC/polyester and Noryl* PA/PPE resins, competing directly with sheet steel, aluminium and SMC. The target is light-weight but stiff designs utilizing the superior impact strength of these polymers for excellent energy management. With a coefficient of thermal expansion of $<2 \times 10^{-5}$ mm/mm/°C, they fit precisely in between aluminium and steel. Their modulus of elasticity exceeds >15.000 MPa.

Similar to HMD, GE Advanced Materials is pursuing is HPPC technology in three directions. An HPPC material based on Xenoy* PC/polyester resin for off-line painted applications is expected to become available before the end of this year. HPPC materials with a matrix of classical as well as high-heat Noryl* PA/PPE resins are in still in the earlier development stage..



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