

# Meet the extreme: how do DSM's plastics boost e-mobility?

The development of electrical, interconnected and autonomous mobility is gaining momentum, with advanced polymer technology at the forefront of innovation in many key areas. The focus is on solutions setting completely new standards in performance, functionality and reliability.

The global automotive industry is facing fundamental changes. The concepts of future mobility are governed by trends that are challenging the classical driving experience and conventional drives. The automobile is gradually transforming into a “third living environment” next to the home and the workspace. What has long become commonplace there – clean energy, intelligent information technology and higher quality of life, is now put on wheels.

New engine technologies are enhancing the “joy of driving”. Beyond connecting people, intelligent communication networks are increasingly integrating the vehicles themselves into the “internet of things”. The risky job of the driver is giving way to the faster reaction, greater convenience and higher safety of autonomous mobility systems.

## Increased Challenges

From the point of view of material innovation, this development is not so much a question of time but determined by hard and soft compliance factors, from regulatory provisions to consumer acceptance.

Above all, the dynamic evolution of new drive concepts as well as the growing interconnection of vehicles for increased autonomous mobility have raised the bar of functionality and reliability for materials, including engineering plastics. In particular, this applies to electronic components and can be illustrated in three key areas where integrity and safety of systems are paramount:

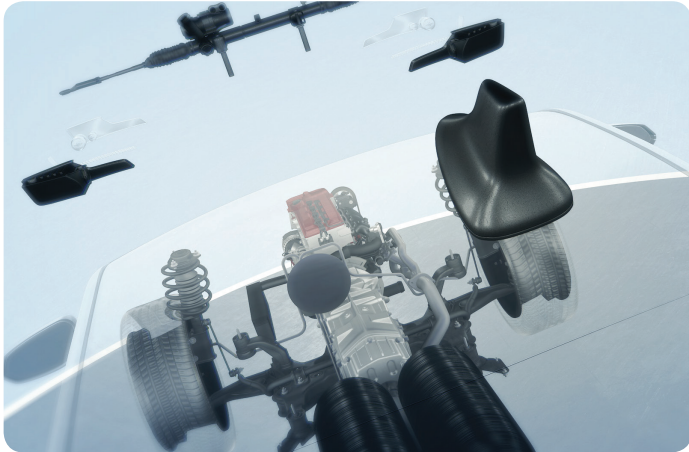
- Consolidated design for functional integration in limited space
- Active thermal management, including heat removal
- Effective shielding against electromagnetic interference (EMI)

## Consolidated Design

As interconnected mobility entails more and more electronic functions, designers are asked to make the most economic use of an ever smaller space available. Plastics provide an inherently design flexibility wide window for functional integration and part consolidation, and high-performance polymers – such as ForTii® from DSM – offer the required quality and reliability for zero-ppm defect designs. Both are instrumental for the operational safety and integrity of critical electronic systems in the rugged driving environment.

In addition, such high-performance consolidated components also help to optimize manufacturing processes for enhanced productivity and cost efficiency. An example of this is the Laser Direct Structuring (LDS) process, in which the required conductive paths are directly laser engraved on the surface of three-dimensional molded substrates and then electroless plated with layers of copper, nickel and gold.

Upcoming applications of this advanced technology includes various sensors, switches, camera modules, where either a higher function density, an optimized design for performance, or smaller size can be achieved. In the case of roof-mounted antenna, the LDS process enables true conformal design of the antennas needed for various communication protocols, such as GPRS, LTE, ITS-G5, etc.



DSM now has a series of LDS materials; all based on polyamide 4T and branded ForTii. Compared to rival liquid crystal plastic (LCP) materials suitable for LDS, ForTii grades are lower in cost and offers excellent plating behavior (see figure 2), weld line strength (see figure 3) as well as dielectric properties. With some materials, the variability in the plating process when lines are designed to be very thin and very close together causes one or both of two phenomena: lines that are supposed to be continuous exhibit discontinuities (a phenomenon known as skip plating); and/or overplating causes adjacent lines to touch, which will lead to short circuits in use. Obviously, neither phenomenon is acceptable. It is therefore critical to use a material that is tolerant to variations in the plating chemistry.

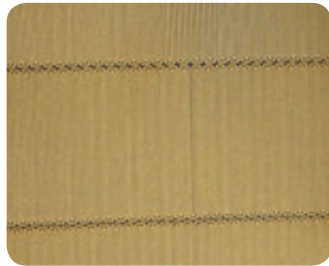


Figure 2: ForTii LDS fine line capability

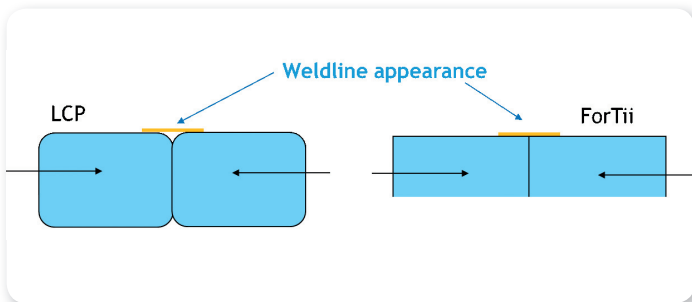


Figure 3: Difference in weld line appearance between LCP and ForTii

The successful implementation of LDS technology in the automotive environment requires materials like ForTii, which offer high strength and rigidity at room and elevated temperatures as well as reliable long-term performance in harsh conditions.

### Effective Heat Removal

Thermal management is focusing on effective heat removal. The smaller the space available, the more important it is that materials will not only stand but also dissipate the heat generated by and in the components.

Although plastics are better known as insulators, thermally conductive engineering polymers have long been an important part of DSM's material portfolio. For example, existing basic Stanyl® and Arnite® grades are widely used in lighting applications and electric motors, providing excellent thermal conductivity in the critical range up to 15 W/mK. Then again, the insulation of coils in electric motors requires plastics with a very low viscosity next to adequate heat resistance.

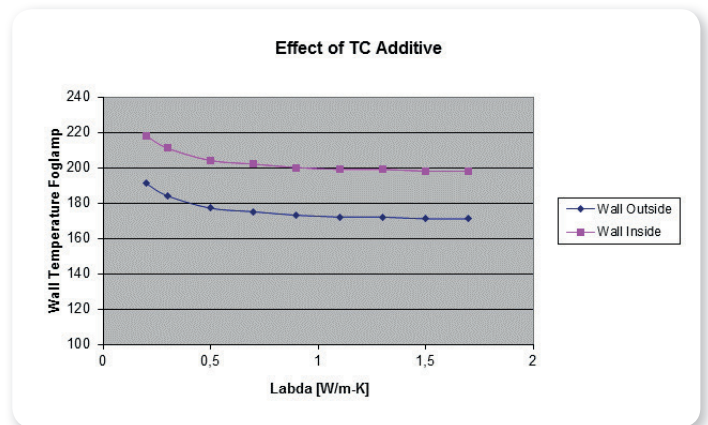


Figure 4: Effect of the thermally conductive filler in Arnite XL - T on the inside (magenta) and outer wall temperature (blue) of a fog light housing

Matching the forecasted trends with regard to the increasing number and higher performance needs of electronic components – not least of new electric powertrain concepts, DSM continues to drive the development of thermally conductive materials for its automotive customers. Critical is a stable polymer base and an effective design of the conductive network, both in terms of loading and material compounding.

### Reliable EMI Shielding

With the increasing use of electronic systems in vehicles, operational safety and zero-defect tolerance have gained an importance that places enormous demands on material properties - and even more so when seen in conjunction with faultless autonomous driving.

Today's automotive electronics already, whether interconnected or not, is processing several gigabytes of data, which is expected to multiply within the next decade. Existing systems span from power steering and automatic cruise control to tire and airbag pressure monitoring, not to forget navigation and infotainment units. The reliable delivery of this vast amount of digitized information requires an effective shielding of electronic components against – and from causing – electromagnetic interferences.

There are several ways of ensuring this critical function from a material standpoint. Best results can be achieved with fully metallic enclosures, however involving substantially higher costs and significantly higher weight compared to plastic designs.

The latter can be summed up in three categories: Cost-efficient applications without any special thermal management requirements are often housed in commodity plastics with an electrically conductive coating, which may however scratch and delaminate under more demanding conditions. Carbon fiber filled engineering polymers offer good thermal and electrical conductivity with the added benefit of allowing material engineers to customize the desired EMI shielding performance by means of the fiber content. Highest requirements are met by combining the carbon filled polymer with an additional thin conductive layer. The potential weight savings of engineered plastic solutions vs. aluminum are as high as 30 percent.

Furthermore, DSM's portfolio of conductively modifiable polymers also comprises EcoPaXX®, a particularly sustainable PA 4.10 derived up to 70 percent from castor beans. The material is at the heart of advanced carbon fiber filled composite formulations that are being developed for lightweight structural components combining high heat resistance with excellent EMI shielding characteristics.

## Conclusion

Due to their reliable performance and their versatility, high-quality engineering plastics will play an increasing role in future mobility concepts. Especially the rapid evolution of interconnected and autonomous driving, the absolute necessity of zero-defect tolerance, the growing electronic density and shorter design cycles are providing big opportunities for material innovation, which DSM as a global leader in engineering plastics has recognized and is determined to seize together with its customers.

DSM's material development for the world of electrical, interconnected and autonomous driving is based on an innovative and advanced materials portfolio for the automotive and electronics industry as well as on years of experience in safety-critical applications, such as brake boosters and airbags. DSM knows how to implement zero-defect tolerance in product and process design. Its engineering plastics are used in 87 percent of all new vehicles manufactured worldwide, and there is at least one DSM material in almost any mobile device, such as notebooks, PDAs and mobile phones.

Contact us at DSM today to discover how plastics can help you meet the extreme in automotive design.

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