ELSEVIER

Deploying cutting-edge surface treatment technology to develop lightweight and affordable composites for use in future automotive application

FEATURE

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Vehicle lightweighting is arguably the most keenly discussed topic in today's automotive industry. The cars that roll off the manufacturer production lines in the future need to become lighter to meet Global Emissions Targets that are fast approaching and focus on strict fuel efficiency and CO_2 emissions targets. But, finding the best material solutions to reduce weight – safely and affordably – is a sizeable challenge.

To understand the size of the task that vehicle manufacturers are facing, you only have to look at some of the legislative requirements that have been laid down in the USA. The Corporate Average Fuel Efficiency (CAFE) standards across the Atlantic currently state that future passenger vehicles must average 54.5 miles per gallon by 2025. That's a significant MPG figure and, realistically, can only be achieved by implementing a considerable amount of cutting-edge lightweighting technology (Fig. 1).

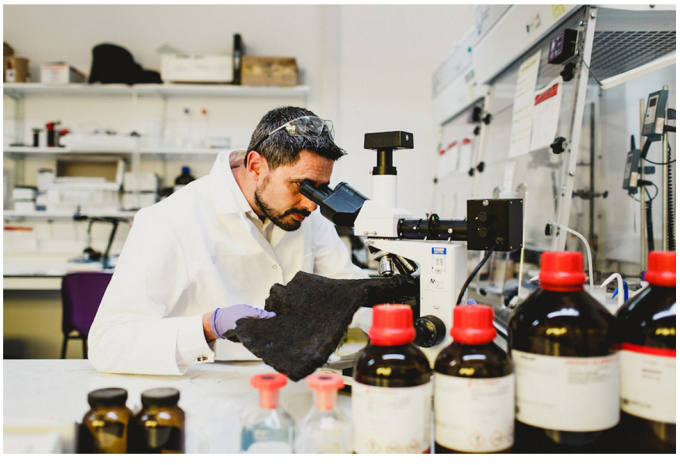

FIGURE 1

OAS Technology Manager Dr. Jon-Paul Griffiths believes there is a hunger to try new materials and embrace change in the automotive industry.

And when you consider that with global vehicle production expected to increase from 88.7 million in 2015 to more than 110 million units by 2025, any vehicle lightweighting solution that's rolled out needs to be robust and reliable to satisfy the manufacturing demand that will be faced in future years.

To that end, automotive design is sensibly moving from steel as the 'go to' material for automotive assembly to other lightweight materials that could deliver the weight saving and performance that's required. The desire to lightweight is tempered, however, by the cost of the material and its ability to be processed in an automotive manufacturing environment.

A migration to the use of lightweight metal steel alternatives such as magnesium, high-strength steel and aluminum is therefore something that designers and engineers across the world are currently evaluating.

As well as being lightweight, many of these alternative materials also share a common ancestry in processing and assembly with steel and therefore can be amalgamated into the traditional vehicle manufacturing process with a lesser degree of change.

But it is generally believed that the use of these materials will not provide the lightweighting gains that are being targeted to meet impending Global Emissions Targets.

This realization is therefore paving the way for thermoplastic and thermoset composite materials to potentially be used in more mass-market automotive applications.

However, the transition across to thermoplastic and thermoset composites is not a simple one that can be completed overnight. And it's widely accepted that consumers won't be prepared to pay for the development of next-generation lightweight material technology and efficiency on their own.

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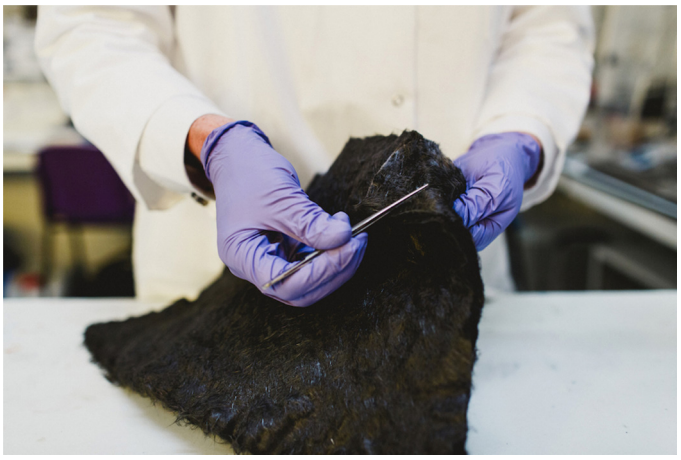

FIGURE 2
OAS is using commercially-available recycled carbon fiber mat and is working alongside the University of Manchester.

That means the lightweighting solutions that the automotive industry develops and embraces in the future must balance material weight, performance and cost carefully.

But moves are currently afoot to face the vehicle lightweighting challenge head on and significant progress is being made, particularly when it comes to looking at how waste carbon fiber can be used to develop a new breed of lightweight composite materials for potential use in future automotive applications.

Surface preparation and advanced materials specialist, Oxford Advanced Surfaces (OAS), is currently conducting a feasibility study – entitled 'rescued carbon fiber for use in the automotive industry' – and is investigating how cutting-edge fiber sizing surface treatments can be developed and used to create a new breed of lightweight composites from commercial grades of recycled carbon fiber (Fig. 2).

Scratch beneath the surface and you quickly realize that research into finding a new use for recovered and recycled carbon fiber that is already commercially available makes perfect sense.

Firstly, the lightweight qualities, stiffness and strength of carbon fiber have been known for decades. After all, the forward-thinking McLaren team built Formula One's first carbon fiber monocoque way back in 1981 – a move that subsequently revolutionized performance and safety in the sport.

Secondly, when you consider that around 30% of all carbon fiber that's produced globally is discarded as waste during the manufacturing process, it doesn't take long to realize that recovered carbon fiber is clearly a resource that shouldn't be overlooked when looking at the development of new and affordable composites.

And when you also factor in that the current annual market for the global production of carbon fiber stands at 60,000 metric tons – and is predicted to increase to around 140,000 metric tons by the 2020s – the case for using recovered and recycled carbon fiber in beyond compelling.

The OAS study is being funded by a £233,000 Innovate UK grant that supports Integrated Delivery Program 12 (IDP 12); a funding initiative backing scientific projects with the potential to appreciably reduce the weight of vehicles and CO_2 emissions.

In delivering its feasibility study, OAS is working alongside The University of Manchester, a center that has extensive experience in composite processing and testing.

''This is a really exciting study,'' OAS Technology Manager, Dr. Jon-Paul Griffiths says. ''Composites are fascinating materials in their own right but when you're developing new composites for potential automotive applications, you're working on another level that could have a significant and long-lasting impact for years to come.

''The fast pace of change and the adoption cycle that engineers are having to deal with to bring new materials to lightweight in the automotive industry is fascinating. There's a real hunger to try new things and change. From a materials perspective, it's great to be part of that process.''

In delivering its feasibility study, the team of scientists at OAS is developing the firm's existing Onto™ surface treatment technology to give life to a new breed of composites that will be completely unique and hopefully provide the versatility that the automotive industry is looking for in affordable, lightweight material solutions (Fig. 3).

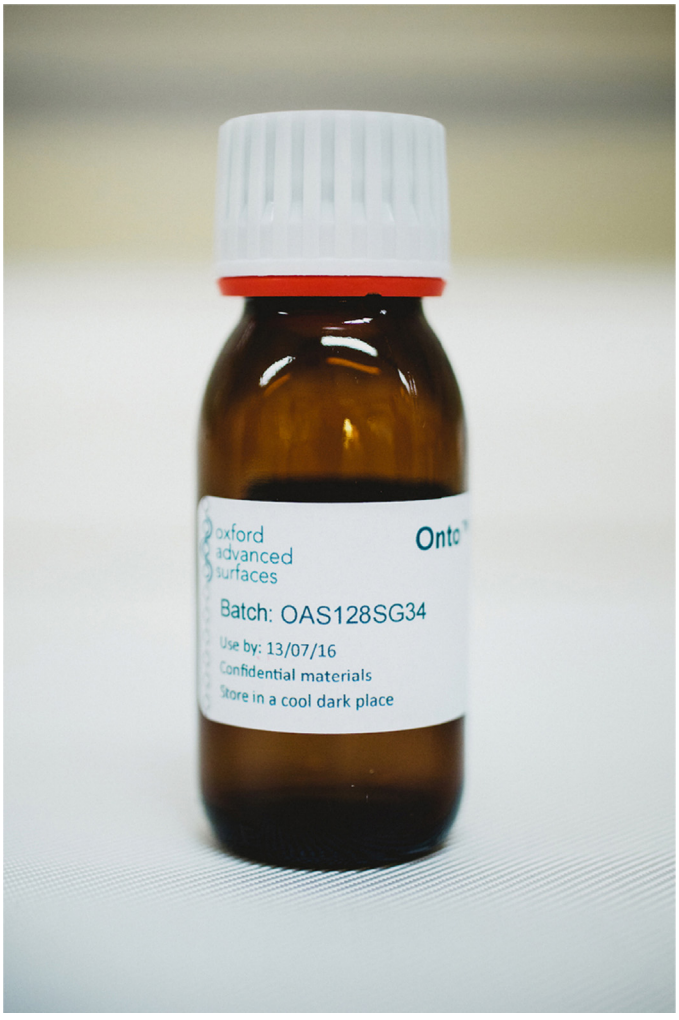

FIGURE 3
OAS scientists are developing the firm's existing Onto™ surface treatment technology during their recycled carbon fiber feasibility study.

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