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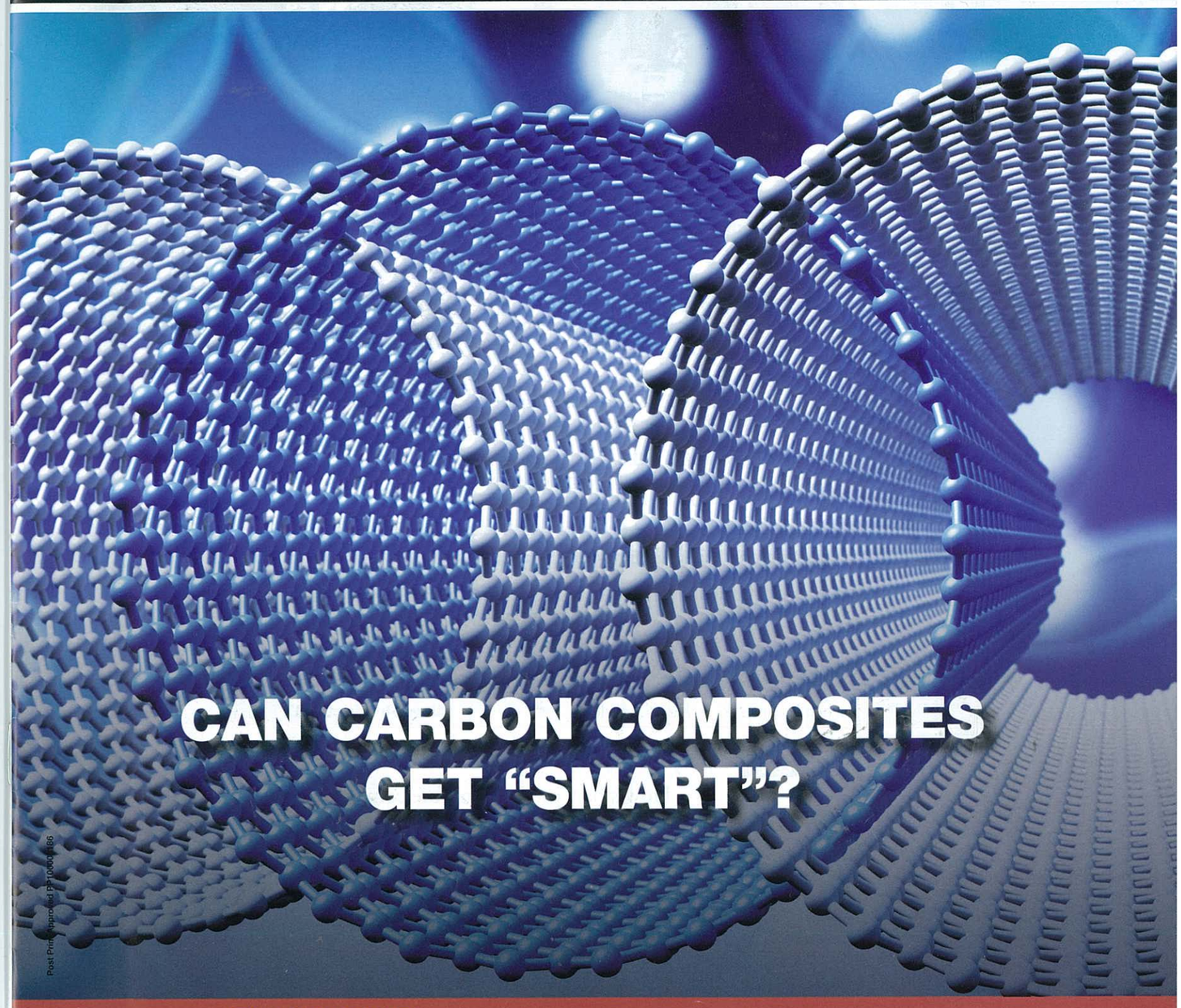

CAN CARBON COMPOSITES GET "SMART"?

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EXCLUSIVE: Uni students win award for hull cleaning robot

they are able to collect data and information about the performance of the processes.

"One of the projects I have been working on relates to the real-time monitoring of the manufacturing process for composites themselves. It's very much the same technology, but it is being used in a different approach, this time involving graphene-enabled components in the production of composites," Hameed said.

The information that can be gathered through this process monitoring, such as on optimal temperature and pressure and material flow, can help eliminate defects in composite materials. "Ordinarily, as these composites are multi-component systems or hybrid systems, where three or more materials are mixed together, it is often the case that defects will be formed in the manufacturing process, leading to imperfections and inconsistencies," said Hameed.

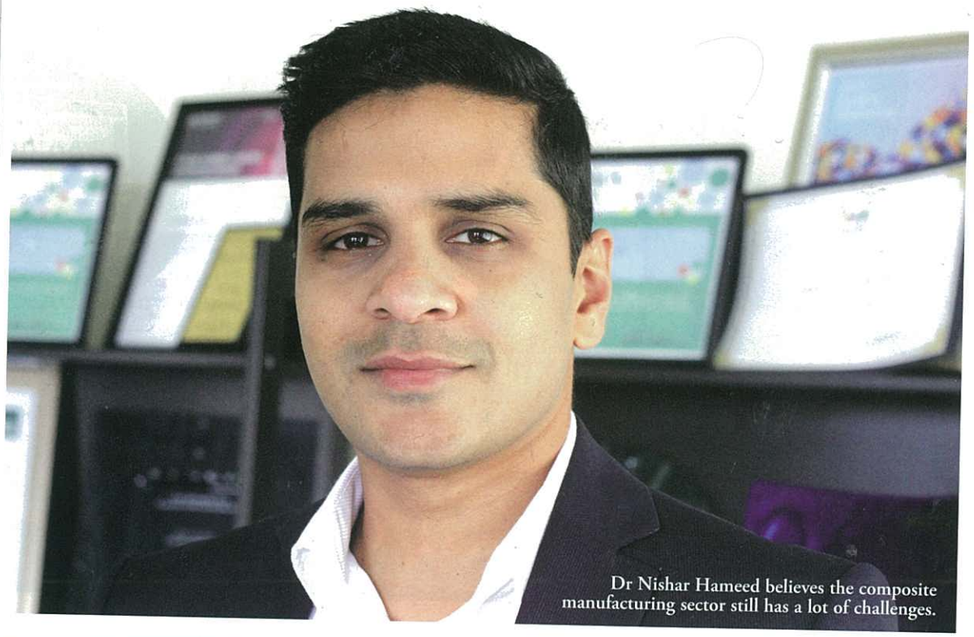
Additionally, the optical fibres that have traditionally been used to monitor the process of composite manufacturing also cause defects to the material, as these fibres are much thicker than the fibres in composites.

Using nano-materials such as graphene means that this issue is eliminated, Hameed said. Furthermore, having a smart manufacturing process that can be monitored in minute detail means that the consistency and quality of the material can be maintained. Because sensors are integrated into the material, it means that performance data will be continued to be recorded. "It's like having a digital passport within the composite that enables you to record data, both during and after manufacturing," said Hameed.

"There's actually a double-advantage: on the one hand, graphene can reinforce your composites so that they have better mechanical properties compared to a traditional composite. On the other hand, you have the integration of smart functionalities within a single combine.

"There are challenges, of course. For instance, how do you balance the mechanical and smart functions of a composite? You need to have the right formulations and the right engineering techniques to be able to carry this out effectively. This is an area where we are doing a lot of research."

While composite materials have a highly established supply chain, there are challenges to the commercial production of smart composites. Hameed said the benefits of graphene in the enabling of smart functioning in composites is that they can be produced in large volumes at a relatively low price. However, the commercialisation of graphene products is still in its early stages. "One of the areas of focus for us is to really help this process along. We are studying graphene so that we can understand its structure properly and enable better provision of the right types of graphene for the right applications," he said.



Dr Nishar Hameed believes the composite manufacturing sector still has a lot of challenges.

"One of the areas of focus for us is to really help this process along. We are studying graphene so that we can understand its structure properly and enable better provision of the right types of graphene for the right applications,"

Hameed indicated that his team would be pressing forward in integrating a number of innovative ideas they have been working on to date. "We are primarily focused on bringing composite manufacturing up to Industry 4.0 standards. The sector still has many challenges in front of it," he said. "In many respects, composite manufacturing is still Industry 2.0; the process is still frequently carried out by manual labour."

Bringing composite manufacturing into the fourth industrial revolution would mean making strides in automating the process, according to Hameed. Swinburne University will be establishing Australia's first Industry 4.0 test lab focused on composite manufacturing. "In about six to eight months, we will have a fully established lab where we will have a digital and efficient process that will be a world-first – a completely innovative 3D printing approach for making carbon fibre composites," Hameed said.

Hameed and his team have also been working on rapid-cure epoxy resins. Epoxy usually takes many hours to cure to make composite parts, which has been a challenge for creating large volumes of the materials for commercial production. The Swinburne researchers have recently developed a new solution where epoxy can cure within 50 seconds.

Hameed said these different projects – the development of smart functionalities, digital manufacturing technologies, automation processes and a rapid-cure resin system – are parts of the wider puzzle that his team is fitting together in order to bring composite manufacturing into the fourth industrial revolution.

"We are trying to fit these areas together, so that we have a completely automated Industry 4.0 process to rapidly manufacture smart composite material. That is the ultimate goal we want to achieve.

"And this requires a multi-disciplinary approach. We are bringing together people from many different areas of research and speciality.

"This is the ultimate goal of the Manufacturing Futures Research Institute, where we have individuals from different disciplines all working together to address manufacturing challenges for Australian industries."

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