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**inVia™ Raman microscope aids the development of the world’s lightest mechanical watch**

In January 2017, the world’s lightest mechanical chronograph watch was unveiled in Geneva, Switzerland, showcasing an innovative composite material containing graphene. Now the research behind the project has been published with the Renishaw inVia Raman microscope playing an important role in the development of the material.

The precision-engineered watch was a result of a collaboration between The University of Manchester, Richard Mille Watches and McLaren Applied Technologies. The RM 50-03 and its strap only weigh 40 grams. Its case, that houses the watch mechanism, is made from a unique composite material that incorporates graphene to give high strength but low weight.

The work was primarily carried out by a group of researchers at The University of Manchester’s National Graphene Institute. The research behind this unique watch has been published in the journal, *Composites Part A: Applied Science and Manufacturing* [1]. In the research, the distribution and orientation of the graphene in the composites were determined using a Renishaw inVia Raman microscope.

The collaboration was an exercise in engineering excellence, exploring the methods of correctly aligning graphene within a composite to exploit the two-dimensional material’s superlative properties of mechanical stiffness and strength, whilst negating the need for the addition of other denser materials.

Professor Robert Young, who led the research, said: “In this work, through the addition of only a small amount of graphene into the matrix, the mechanical properties of a unidirectionally-reinforced carbon fibre composite have been significantly enhanced. This could have future impact on precision-engineering industries where strength, stiffness and product weight are key concerns, such as in aerospace and automotive.”

A small amount of graphene was added to a carbon fibre composite to improve stiffness and reduce weight, by requiring the use of less overall material. Since graphene is stiff and strong it shows huge potential for further enhancing the mechanical properties of composites.

The final results were achieved with only a 2% weight fraction of graphene added to the epoxy resin. The resulting composite was then analysed by tensile testing, Raman spectroscopy and X-ray CT scans.

This research demonstrates a simple method by which graphene can be incorporated into existing industrial processes. It allows engineering industries to benefit from graphene’s mechanical properties, in applications such as the manufacture of airplane wings or the body work of high-performance cars.

The research group discovered that, when comparing with a carbon fibre equivalent specimen, the addition of graphene significantly improved the tensile stiffness and strength. This occurred when the graphene was dispersed through the material and aligned in the fibre direction.

Dr Zheling Li, a University of Manchester Research Associate, said: “This study presents a way of increasing the axial stiffness and strength of composites by simple conventional processing methods and clarifying the mechanisms that lead to this reinforcement.”

Aurèle Vuilleumier, R&D Manager at Richard Mille, said: “This project is a perfect example of technology transfer from the university to the product. The partnership with McLaren Applied Technologies allows a broad diffusion of graphene-enhanced composites in the industry. As a tangible result, a world record light and strong watch was available for our customers: the RM 50-03.”

Dr Broderick Coburn, Senior Mechanical Design Engineer at McLaren Applied Technologies, said: “The potential of graphene to enhance composites’ structural properties has been known and demonstrated at a lab-scale for some time now. This application, although niche, is a great example of those structural benefits making it through to a prepreg material, and then into an actual product.”

The University of Manchester will soon be celebrating the opening of its second world-class graphene facility, the Graphene Engineering Innovation Centre (GEIC), later this year. The GEIC will allow industry to work alongside academics to translate research into prototypes and pilot production and accelerate the commercialisation of graphene.

More information about the collaboration and the work involved can be found at <https://www.manchester.ac.uk/discover/news/worlds-lightest-mechanical-watch-revealed-thanks-to-graphene/>

Images and content courtesy of The University of Manchester.

**References**

1; Jingwen Chu et al. “Realizing the theoretical stiffness of graphene in composites through confinement between carbon fibers”, *Composites Part A: Applied Science and Manufacturing* **113**, 311-317 (2018). **DOI**: 10.1016/j.compositesa.2018.07.032

**About Renishaw**

Renishaw is one of the world's leading engineering and scientific technology companies, with expertise in precision measurement and healthcare. The company supplies products and services used in applications as diverse as jet engine and wind turbine manufacture, through to dentistry and brain surgery. It is also a world leader in the field of additive manufacturing (also referred to as 3D printing), where it is the only UK business that designs and makes industrial machines which ‘print' parts from metal powder.

The Renishaw Group currently has more than 70 offices in 36 countries, with over 4,500 employees, of which 3,000 people are employed within the UK. The majority of the company's R&D and manufacturing is carried out in the UK and for the year ended June 2018 Renishaw achieved sales of £611.5 million of which 95% was due to exports. The company's largest markets are China, USA, Germany and Japan.

### **For further information**

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