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Breakthrough in Graphene-Reinforced Composites

(*Nanowerk News*) Haydale, the developer of a unique plasma functionalisation process for nanomaterials, has announced the publication of research showing its functionalised graphene nanoplatelets (GNP) significantly improve the nanoreinforcement of resin. The research, conducted by the Material Science Department at AeroSpace Corporation, has been published in the *Journal of Applied Polymer Science*.

The report states significant strength improvements in toughened epoxy composites. The reported increases are >2x in tensile strength and modulus of an epoxy composite using a number of HDPlas™ O2-functionalised GNP, manufactured by Haydale. The addition of increasing amounts of GNP resulted in strength increases of over 125% and toughness improvements of 100% over that of similarly cured, unreinforced material.

The results underline the potential Haydale's tailored, plasma functionalisation process has for realising the 'miracle' material's potential. Having been heralded to revolutionise the 21st Century due to its physical and mechanical properties, questions still remain over the commercial reality in delivering graphene and the relevance it has to real products. The Haydale plasma functionalisation process has the potential to offer the tailored functionalisation of graphene nanomaterials whilst maintaining structural integrity thus eliminating a key barrier to the commercialisation of graphene.

The research aimed to determine whether properties such as matrix material composition, the degree of exfoliation of graphene and the filler concentration, size, aspect ratio and treatment method, could maximise the physical potential of the matrix material. The GNP nanofiller material was plasma-treated using the HDPlas™ O2-functionalised process before being incorporated into the epoxy resin. Once the composite material had been manufactured, it was analysed and the effects of GNP loading on mechanical performance were assessed.

Ray Gibbs, CEO of Haydale commented, "Graphene nanomaterials are gaining enormous interest as a new class of reinforcement for nanocomposites, promising revolutionary electrical, thermal and mechanical properties. The results presented in the new research represent a step forward for the graphene industry in terms of realising graphene's potential in the composites market, and further highlights that functionalisation via plasma is the key to realising graphene's potential. Following this research, we intend to test our functionalised nanomaterials in further research projects with both raw material producers and end-application manufacturers."

Graphene has such fantastic potential to transform the composites industry, but requires

specific functionalisation without damaging the material structure or adding impurities. In order to optimise the material's physical and mechanical properties, good dispersion and structural uniformity of the nanoparticles is the key to making real progression. Graphene is highly inert, and is subsequently difficult to bond it with or disperse it within other materials. Current methods for functionalising graphene involve thermal and chemical shocking agents which whilst allowing for scalable production, can cause significant damage to the material's structure, leading to defects in the final product.

About Haydale

Haydale has developed a patent pending proprietary scalable plasma process to functionalise graphene and other nanomaterials. This enabling technology can provide Haydale with a rapid and highly cost efficient method of supplying tailored solutions to enhance applications for both raw material suppliers and product manufacturers.

Functionalisation is carried out through a low pressure plasma process that treats both organic mined fine powder and other synthetically produced nanomaterial powders producing high quality few layered graphenes and graphene nano platelets. The process can functionalise with a range of chemical groups, where the amount of chemicals can be tailored to the customer needs. Good dispersion improves the properties and performance of the host material and ensures it delivers as specified.

The Haydale plasma process does not use wet chemistry, neither does it damage the material being processed, rather it can clean up impurities inherent in the raw material. The technology is a low energy user and most importantly environmentally friendly. The Haydale method is an enabling technology where working with a raw material producer can add value to the base product and tailor the outputs to meet the target applications of the end user.

Haydale, based in South Wales, housed in a purpose built facility for processing and handling nanomaterials with a laboratory facility, is facilitating the application of graphenes and other nanomaterials in fields such as inks, sensors, energy storage, photovoltaics, composites, paints and coatings. www.haydale.com

Source:
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