Innovate UK

Results of Competition: Targeting higher potential graphene applications
Competition Code: 1509_FS_EMERG_GRAPH2

Total available funding for this competition was £2.5M from Innovate UK and EPSRC

Note: These proposals have succeeded in the assessment stage of this competition. All are subject to grant offer and conditions being met.

Participant organisation names	Project title	Proposed project costs	Proposed project grant
Precision Varionic International Ltd Dycotec Materials Ltd University College London (UCL)	Endurance - Graphene based coatings for durable wear resistant low cost position sensors	£247,313	£188,109
Project description - provided by applicants			
In recent years there has been an exponential increase in embedded electronics within cars as OEMs strive tosatisfy consumer demand for greater comfort, safety, convenience, reliability, fuel efficiency, infotainment andfun, and stringent legislative targets for automotive emissions. Position sensors represent a key enablingtechnology used for monitoring and control of systems throughout the car, from engine management throughto pedal position monitoring. Consumers demand intelligence as standard and at no extra cost. The state of theart provides two sensor types: i) contact based devices (low performance at low cost); and ii) non-contactdevices (high performance at high cost). Utilising the unique properties of graphene based coatings (wearresistance combined with customised conductivity and barrier) the ENDURANCE consortium will assess thefeasibility for development of a low cost high performance linear and encoder position sensors enablingrealisation of disruptive solutions meeting well defined user needs. The ENDURANCE technology has thepotential to extend far beyond the automotive market (£770m) to secondary markets worth >£7.4 billion.			

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Nano Products Ltd Plessey Semiconductors Ltd Thomas Swan & Co. Ltd Nottingham Trent University University of Strathclyde	FlexiLEDs with printed graphene based thermal management	£249,148	£201,542
Project description - provided by applicants			
A new Uk based mass manufacturing technology will create flexible plastic sheets with embedded electronicsand microscopic light emitting devices. High compressed graphene flakes connected to the devices will allowheat to be drawn away from the devices so they carry on working efficiently. Formed into many shapes andsizes the devices could be placed anywhere. They could form part of the exterior of cars and vans to provideadvertising or indicator and brakes lights. On the inside they could provide efficient video displays forpassenger. In the home the devices could be built into the walls, ceilings and floors to allow endlessopportunities for lighting the home. By using graphene to remove the heat these devices will use less energyand last for longer.			

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Applied Graphene Materials UK Ltd Sherwin-Williams Protective & Marine Coatings TWI Ltd	GRAphene protection Coatings (GrACe)	£249,217	£205,597
Project description - provided by applicants			
Each year, it is estimated that corrosion costs the economy £10 billion per annum in the repair, maintenanceand replacement of structures in Britain. Organic coatings loaded with hazardous or environmentally unfriendlymetals such as zinc and chromates are commonly used to protect such structures and so it is desirable to findimproved 'green' alternative solutions. Graphene has been identified as a suitable 'green' anti-corrosiveadditive and Project GRACe will investigate and develop the potential of graphene based anti-corrosivecoatings. In addition, graphene has been identified with the ability to mitigate risks of fires, so GRACe will alsoexplore the potential for using graphene in fire retardant, protective coatings.			

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NetComposites Ltd Emyrus Ltd University of Sheffield Marshall of Cambridge Aerospace Ltd	Inkjet Printing of Plasma Functionalised Graphene to Deliver Multifunctional Polymer Composites for Aerospace Applications (PlasmaGraph)	£249,759	£185,631

Project description - provided by applicants

The objective of the PlasmaGraph project is to develop a method by which plasma functionalised graphene can be selectively deposited onto fibre reinforced composites to deliver multi-functionality to aerospace structures.There are three main elements to deliver to meet this overall objective:- Plasma functionalised graphene; to prevent the re-agglomeration of the graphene in a dispersion and the re-agglomeration of the graphene can both reduce the inherent properties of the graphene and, for inkjet printing, prevents use of graphene dispersions as the re-agglomerated material can block print heads;- Inkjet printing of graphene dispersions onto fabric preforms; this allows the selective placement of graphene into structural composites and will deliver multifunctional benefits;- Manufacturing of graphene functionalised composite components; this requires the inkjet printed grapheneto remain in-situ when the final composite part is manufactured so that the benefits are retained, but also so that there is no release of the graphene to the environment during processing.

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Oxford Instruments Nanotechnology Tools Ltd NPL Management Ltd University of Manchester	Industrial feasibility test of a graphene-enabled turnkey quantum resistance system	£248,936	£161,013
Project description - provided by applicants			
Graphene enabled Quantum resistance system will provide the high-end electronics instrumentation industrywith a primary resistance standard which can be used directly on the factory floor dramatically reducing thecalibration traceability chain and improving the precision of electronics instrumentation. The quantum Halleffect (QHE) is one of the most fundamental phenomena in solid-state physics. Its observation in graphene wasthe litmus test that proved that this material is a true 2-dimensional crystal of the highest quality. The QHE isalso the cornerstone of electrical metrology as it is the primary realisation of the unit for resistance, the ohm.The proposed turnkey system will be cryogen free and operating at low magnetic fields. It will enableresistance calibration with unprecedented accuracy to indusrial companies and reduce the cost and time fromdesign to product.			

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ProGnomics Ltd NPL Management Ltd University of Cambridge Unilever UK Central Resources Ltd	Graphene Sensors for Food Allergen Detection	£248,295	£175,860
Project description - provided by applicants			
Exceptional electronic properties, surface sensitivity and selectivity, makes graphene sensors ideal for foodsafety applications. Novel, generic, real-time monitoring sensor technology, based on chemically modifiedgraphene channels, will be demonstrated for the detection of peanut allergens in food products. Tracequantities of nuts can be present in food processing plants at very low concentrations and can trigger animmune response in allergic individuals, ranging from hives to severe gastrointestinal and respiratorysymptoms, and in serious cases - anaphylactic shock. Where there is a possibility of cross-contamination, foodproducers are obliged to label products or recall incorrectly labelled products ' costing industry millions andproducing negative publicity. Our real-time sensor system, developed for in-situ monitoring of food & foodprocessing units, would enable instant and low-cost monitoring. Using chemically modified graphene,integrated into a packaged allergen sensor, for in-situ monitoring would offer end-user Unilever a realbreakthrough in monitoring for trace nut contaminants.			

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Meggitt Aerospace Ltd Haydale Composite Solutions Ltd	The effect of graphene additions to carbon-carbon composite materials	£249,001	£148,708
Project description - provided by applicants			
Project Creosote investigates the potential of graphene additives to Carbon/ Carboncomposites in a range of thermal management applications.			

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Haydale Composite Solutions Ltd University of Warwick Huntsman Advanced Materials (UK) Ltd	INdustrial PRocessing Of Nano Epoxies (INPRONE)	£248,701	£205,191
Project description - provided by applicants			
The aim of this interesting project is to prove the feasibility of upscaling the manufacture (using industrially relevant processes) of Graphene enhanced epoxy masterbatch. In doing so we will prove that we can impart radical improvements in thermal properties of epoxy resins that have previously only been shown at academic and lab scale level. Additional improvements may also be seen such as material durability, resistance to wear and improvements in thermal cycling.			

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DelStar International Ltd Thomas Swan & Co. Ltd Haydale Ltd University of Bradford	GraNet	£192,018	£157,903
Project description - provided by applicants			
This project uses graphene to produce composites with polyolefins to give a step change in performance forlightweight extruded oriented products used in specialist applications. The project team will; gain an understanding of how graphene can enhance the performance of polymer composites, especially inrelation to physical strength and operating temperature. develop techniques to achieve dispersion of graphene into a polymer matrix at production scale withoutdamaging the platelet structure and reducing the benefits of addition. understand what impact graphene has on polymer processability and rheological properties, including trialsat production scale (processing up to 2.5kg of graphene to produce 250kg of composite) model the impact that addition of graphene has on product cost at predicted volumes. develop a value proposition for prototype products and gain feedback from customers in the target markets			

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Tata Steel UK Ltd University of Cambridge	Graphene coatings on steel for large scale energy storage applications	£206,285	£152,787
Project description - provided by applicants			
From burning firewood to oil, the ability to store energy and use it at our command has been responsible forthe biggest transformations of humanity in the course of history. Today, electrochemical devices, namelybatteries and supercapacitors which are predominantly used for portable energy, are probably the biggestlimitation to the fast development of portable electrical appliances from mobile phones to cars, and significantimprovements in these technologies are urgently required.This project aims to combine graphene with steel as a charge collecting material in batteries and otheradvanced energy storage devices. Graphene is a good conductor as well as a good barrier providingelectrochemical stability of the steel. Success on this project would allow improvements in performance as wellas significant cost reductiosn in batteries and supercapacitors alike.			

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Haydale Ltd University of Bath	Multifunctional skins incorporating carbon (MuSIC)	£198,620	£168,302
Project description - provided by applicants			
This project is a collaboration between Haydale Ltd, Thales and University of Bath. The aim of the project is toassess the feasibility of employing graphene based polymer skins for sensing and deicing applications. The aremajor issues associated with deicing are in aircarft, at airports, transmission power lines, instrumentation,antenna masks, wind turbines and the exploration of cold environments (e.g. oil and gas). Such a sensingsurface can be integrated with thermally active (shape changing) structures to achieve structural deflection forcombined thermal-mechanical de-icing. The opportunity to limit the extent of ice build-up on structures hasbroad application opportunities and enable light weight structures with reduced material costs and fuel savingfor mobile applications and improved performance for instrumentation.			

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