

## Results of competition: Formulated products - meeting the product and process design challenge - Feasibility studies

Total funding available for this competition was £1.3m, provided by the Technology Strategy Board

**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
<b>Applied Enzyme Technology Limited (lead)</b> Food and Environment Research Agency (FERA)	IMEPRINT - Incorporation of Microencapsulated Enzymes into screen PRINTed carbon graphite inks	£100,001	£71,852
<b>Project description (provided by applicants)</b>			
<p>IMEPRINT - Incorporation of Microencapsulated Enzymes into screen PRINTed carbon graphite inks, aims to assess the feasibility of microencapsulating enzymes and mediators for inclusion in a water-based carbon ink. If successful this system will be used to construct biosensors by screen printing. The microencapsulation of enzymes should lead to improved stability of enzymes during the printing process, enhanced enzyme stability and a reduction in the number of printing steps to construct the biosensor. The project thus covers the scope of three technology areas specified in the Technology Strategy Board Formulated Products call, namely formulation for delivery, formulation for stability and formulation for sustainability. This novel application of microencapsulation technology will deliver ingredients precisely to a very specific area on a biosensor. It will improve the stability of all the ingredients encapsulated and replace a solvent based screen printing ink with a water-based environmentally friendly one. The use of this novel ink will lead to dramatic savings in labour costs, operating costs and raw material costs for the production of diabetic test strips and other screen printed biosensors.</p>			

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AQDOT Ltd (lead)	Agrochemical delivery with dynamic orthogonal technology (AGRI-DOT)	£114,292	£86,000
<b>Project description (provided by applicants)</b>			
<p>AQDOT is a spin-out company from the Department of Chemistry, University of Cambridge. The company has developed a platform technology that exploits dynamic and orthogonal supramolecular chemistry to encapsulate a wide variety of materials in one step in aqueous solutions. AQDOT's microcapsules can protect active agrochemical ingredients and ensure that they get to where they're needed, when they're needed – leading to a dramatic reduction in the wastage of valuable cargo. Furthermore, production is inexpensive and potentially uses less energy and less material than current routes. AQDOT provides a unique, innovative solution to the formulation challenges of agrochemicals and other markets.</p>			

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Arecor Limited (lead)	Developing stable liquid Chikungunya vaccines to improve shelf-life and facilitate worldwide distribution	£100,000	£75,000
<b>Project description (provided by applicants)</b>			
<p>Many infectious diseases in developing countries are arthropod-borne viruses (arboviruses). Live attenuated viruses are an effective technology to develop vaccines, but poor stability of these vaccines limits their distribution and use to remote areas of the world where the vaccines are needed most. This project is aimed at determining the major degradation pathways during storage and to develop stable liquid formulations of a Chikungunya vaccine, using a live attenuated vaccine and Arecor's proprietary formulation technology to address the principal pathways of degradation that lead to loss of structural integrity and biological activity. Specific goals of the project include developing liquid formulations capable of a shelf-life of two years at 2-8°C, stability during repeated freeze-thaw cycles, and a minimum three month stability at 25°C to allow for short-term storage and distribution.</p>			

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<b>Britest Limited (lead)</b> Robinson Brothers Limited	Property propagation through process to product	£80,499	£60,374
<b>Project description (provided by applicants)</b>			
<p>Britest Ltd is developing a methodology for assessing how the properties of a complex multi-phase formulation propagate through a process into the products on a qualitative/semi-quantitative basis. The project is a feasibility study to ascertain whether existing tools used by Britest for chemical reaction processes can be modified to gain the required understanding from complex multi-phase formulations. Robinson Brothers Ltd are providing a case study pre-industrial process of a polymer additive to allow development and testing of the methodology and any new tools that are generated in the project. Use of the new methodology and tools will also enable companies to target elements of their process that would warrant more detailed computational modelling (e.g. through the proposed National Formulation Centre).</p>			

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<b>Chrysalis Health &amp; Beauty Business Solutions Ltd (lead)</b>	Sustainable cosmetics from natural sources	£49,473	£28,000
<b>Project description (provided by applicants)</b>			
<p>Beauty product customers recognise the need for their products to be sustainable. They would like the products to be based on sustainable natural materials. However, they will not compromise on performance and sensory properties of the products. Manufacturers must deliver on these customer needs. Cosmetics products contain sustainably derived active compounds. However, the emulsifiers, rheology modifiers, and sensory modifiers are only from petroleum and silicone sources. Natural materials have not been proved to meet customers' needs. Natural materials have seasonal variability and are difficult to process making them less attractive to the manufacturer. The aim of this feasibility research is to fill this gap, to build base technology systems that can be taken forward in future research, deliver natural sustainable products that fulfil customers' needs and meet manufacturing needs. The project will use a range of natural materials from UK companies and will carry out a systematic formulation and evaluation exercise that will assess emulsion efficacy and stability, sensory and sustainability impact of natural systems.</p>			

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<b>Federal-Mogul Friction Products Limited (lead)</b>	Zero copper feasibility in non-asbestos organic (NAO) brake pads - friction product formulas	£112,403	£73,062
<b>Project description (provided by applicants)</b>			
<p>The Federal-Mogul Chapel-en-le-Frith site (North Derbyshire) manufactures friction products (brake pads and shoes) for the automotive and rail sectors. The light vehicle market is a high volume, highly price-driven market. Copper is currently utilised in friction products to add structural integrity, aid heat transfer and reduce juddering during braking. Recent studies have shown that copper from brake dust from cars is a significant contributor to pollution in waterways; this is then toxic to aquatic organisms. As a result of these studies two US states have introduced laws to limit copper content in brake pads to &lt;0.1% by 2025. It is anticipated that similar limits will eventually be rolled out globally. In order to address this issue and protect and grow market share, Federal-Mogul will undertake a feasibility study to remove copper from its light vehicle friction component formulation currently in use, by focusing primarily on the use of 'Non-Asbestos Organic' components as alternatives.</p>			

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Johnson Matthey PLC (lead)	New formulation chemistry for single layer emission control catalysts	£77,403	£50,311
<b>Project description (provided by applicants)</b>			
The project is concerned with the simplification of formulated emission control catalysts for use with cars and trucks for future emissions standards. The project is a feasibility study with the aim to determine whether the proposed research approach has the potential to simplify the current multi-layer catalyst architectures present in many current formulations to single layers and help the integration of separate catalytic functions into single catalytic monolith parts.			

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<b>Lafarge Tarmac Trading Limited (lead)</b> RockTron Ltd; Mineral Industry Research Organisation	Floating photo-catalyst for environmental clean-up	£99,797	£67,880
<b>Project description (provided by applicants)</b>			
This project seeks to apply cutting edge research to produce a novel floating material for environmental clean-up. Using high tech formulation technology an active surface can be coated onto floating granules. These are activated by light to degrade oil and other contaminants. A key feature of these new products is that they are active in the visible range of the spectrum and as a result are far more active than similar materials requiring UV light. The products are also collectable and reusable, enhancing their environmental credentials and lowering costs.			



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<b>MedImmune Limited (lead)</b> Teraview Limited; University of Cambridge; University of Sheffield	THz-TDS: a new insight into protein solution formulation	£96,904	£69,597
<b>Project description (provided by applicants)</b>			
<p>The treatment of some chronic diseases such as rheumatoid arthritis sometimes requires more than a typical pill can deliver. A new generation of so-called 'biopharmaceutical' medicines includes substances which cannot be swallowed because they are destroyed in the stomach. These include 'monoclonal antibodies', or mAbs, which are injected subcutaneously (just below the skin). The preference is for near painless injections through a narrow bore needle. This demands that the industry make concentrated doses in small volumes, retaining low viscosity to allow injection. We need to better understand the phenomenon by which an increase in concentration is sometimes related to unacceptable increases in viscosity. The project team from MedImmune, TeraView and the Universities of Cambridge and Sheffield will develop a new analytical technique using Terahertz radiation, which lies between infrared and microwave radiation. Using this new technique will improve our understanding of the manner in which mAbs interact with each other in high concentration solutions, and in doing so we will be able to make better medicines.</p>			

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<b>Micropore Technologies Limited (lead)</b>	Mesoporous silica formulated using continuous membrane emulsification with reaction	£99,064	£74,298
<b>Project description (provided by applicants)</b>			
<p>A research-based feasibility study using a new manufacturing process to investigate production of specialist formulated particles in a cost-effective and high throughput process with highly defined particle properties. The innovative aim of the project is to use continuous membrane emulsification as a means to formulate particles using physical as well as chemical formulation control, on a large enough scale to meet disclosed industry needs. Specialist particles have been shown to have unique properties for a number of commercial applications. The proposed research is preparatory to 'industrial research' which would build on the results from this initial feasibility study, investigating the behaviour of specific particle formulations in different commercial applications.</p>			

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<b>Polyphotonix Limited (lead)</b> The Centre for Process Innovation	Feasibility of rapid modification of light-emitting electrochemical cell formulations to produce emission spectra on demand (LIGHT)	£99,655	£82,215
<b>Project description (provided by applicants)</b>			
<p>In this feasibility study, the ability to rapidly produce light-emitting organic formulations with a tailored or bespoke emission spectra through intermixing of various emitter species will be undertaken. Instead of manufacturing long chain, multi-functional, electroluminescent polymers with a complex, slow and expensive synthesis path, we will study the feasibility of using accurate formulations of a number of emitters to tailor the emission spectra. Should this prove feasible, then it would be possible to 'dial up' a particular emission spectrum by rapidly formulating known electroluminescent polymer or small molecule constituents. This will allow rapid prototyping of organic light-emitting devices for a number of different niches including, but not limited to, medical devices for phototherapy.</p>			

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<b>Primary Dispersions Limited (lead)</b> University of Strathclyde; The Centre for Process Innovation	Quenching fluid improvement by reformulation with metal oxide nanoparticles (nanoQuench)	£99,818	£82,215
<b>Project description (provided by applicants)</b>			
<p>The material properties of components in many high value applications need to be carefully controlled so that the durability of the components is understood and predictable. One common technique for heat treatment is by quenching. This is time-consuming and can induce residual stresses in the component which need to be relieved to prevent failures in operation. A range of quench media are available, including water, oil and polymer-based, each having specific heat transfer characteristics, which create specific material properties in the quenched components. Closely controlling the precise location and rate of heat transfer during the quenching process would enable more localised mechanical and material properties to be achieved. The objective of nanoQuench is to formulate nanofluids to enable more defined quenching, leading to less residual stresses within the component, allowing end-users greater productivity and cost savings. The final objective of the project is to analyse the nanofluids after quenching to determine how many times they can be used before needing to be replaced and to assess methods for re-use, recycling and safe disposal.</p>			

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<b>Procarta Biosystems Limited (lead)</b> Kuecept Ltd	Formulation development and manufacture of nanoparticulate-based novel antibacterials	£96,482	£72,361
<b>Project description (provided by applicants)</b>			
<p>Procarta is developing a lasting solution to the treatment of bacterial infections using a proprietary technology platform based on nanoparticulate oligonucleotide therapeutics. This project will enable better understanding of how to formulate and manufacture novel nanoparticulate antibacterials, define and fix key QC parameters, leading to a production process for scale up and entry to clinical trials. This manufacturing process will become a strong basis for developing a range of antibacterials able to combat existing and emerging nosocomial infections (MRSA and Clostridium difficile 'superbugs') as well as the emerging threat of Gram negative infections.</p>			

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SciTech Adhesive Systems Limited (lead)	SUStainable PLA adhesives emulsified for flexible packaging FORMulations (SUSPLAFORM)	£80,315	£65,231
<b>Project description (provided by applicants)</b>			
This project is a feasibility study to look at the development and formulation of an emulsified biobased laminating adhesive for flexible packaging applications. The new adhesive system will have good stability, a high solid content and a fast cure speed at low temperatures. It will be suitable for industrial compositing and or anaerobic digestion at end of life.			

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The PJH Partnership Limited (lead)	Selective extraction and modification of tannins for improved sustainability in wine production	£81,691	£61,268
<b>Project description (provided by applicants)</b>			
<p>Demand for lower-cost controlled wine production has led to an increase in the use of oak-replacement products. These allow fine-tuning of flavour profiles, aid stability and accelerate aging, replacing traditional oak barrels which are expensive and unsustainable. PJH has developed novel superheated water technology that allows precise manipulation of the chemical properties of water to replace current multiple cycle extractions which have notable economic and environmental drawbacks. This nine month study will assess the feasibility of selectively extracting multiple materials from various wood sources, producing bespoke tannin blends that provide the desired structural and flavour impacts to wine producers. Objectives include: design of process conditions protocols for rapid, reliable and selective extraction; single cycle methodology; product (sample) validation; process/technology scale-up assessment; and economic appraisal. Collaboration with a leading tannin powder provider will provide industrial steering to the project and support next stage developments and commercialisation, anticipated in 2015.</p>			

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Vectura Ltd (lead)	Formulations for respiratory disease treatment	£118,524	£88,893
<b>Project description (provided by applicants)</b>			
<p>Vectura is developing a series of particle engineered formulation platforms for delivery of dry powder treatments to the lung. At present the majority of treatments on the market are small molecules, although biomolecules are increasingly being developed as alternatives, particularly in difficult-to-treat diseases. Each inhalation product has unique challenges to be solved in order to give physically and chemically stable performance and accurate delivery into the lung. Vectura have identified a number of potentially beneficial formulation methods that could provide solutions to these challenges, for both small molecule and bio-molecule approaches, and want to apply these to real world product development and demonstrate the benefit of applying these approaches in future products.</p>			



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VHSquared Limited (lead)	Formulation feasibility: the optimal dosage form for an oral domain antibody	£99,923	£59,954
<b>Project description (provided by applicants)</b>			
<p>VHSquared Ltd is a venture funded UK biotechnology company exploiting a novel oral antibody platform and low cost manufacturing process to bring ground-breaking products to the market in infectious and auto-immune inflammatory diseases. This Technology Strategy Board grant application supports the formulation stage of development of a new modality for inflammatory bowel disease that can be taken orally. The formulation will allow our VHSquared stabilised domain antibodies to achieve maximum effect. Antibody therapies have revolutionised IBD treatment during the last decade but require injection, are expensive to manufacture, have safety considerations and are subject to loss of response over time. VHSquared intends to harness the dramatic clinical impact of injectable antibody therapeutics and, by developing an oral alternative with a superior profile, benefit both patients and healthcare providers.</p>			

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<b>Viridian Pharma Ltd (lead)</b> Aston University	Development of a novel membrane coating technology for the formulation of orally disintegrating tablets to deliver flucloxacillin	£86,537	£72,386
<b>Project description (provided by applicants)</b>			
<p>Traditionally there has been reluctance in the pharmaceutical industry to carry out clinical trials in children at the time of licensing. This has led to the scenario where many medicines are not specifically designed for use in children, which can result in poor effectiveness. To address this issue, the European Medicines Agency has recently issued a priority list for studies into non-patented medicinal products for children. This project hopes to exploit the objective of this list by undertaking research and development into medicines prioritised for need in children. The successful outcome of this project will be the development of age appropriate formulations for children that will deliver medicines in an appropriate, efficacious and safe manner.</p>			

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XstalBio Limited (lead)	Radical formulations for sustained delivery of small protein therapeutics	£99,753	£74,815
<b>Project description (provided by applicants)</b>			
<p>Many biopharmaceutical companies are developing new smaller biologic drug formulations with the aim of superceding the current generation of expensive monoclonal antibodies with medicines that are better targeted, more potent and cheaper to manufacture. A major drawback of such small biologic drugs is that following administration, usually by injection, they are typically cleared by the body in only a few hours. In this project XstalBio will test a new method of trapping biologic drugs within injectable particles that are designed to slowly release the drug into the bloodstream. These particles contain only ingredients naturally present in the body and if they work as predicted would mean that patients would need a drug injection only once a week instead of twice daily.</p>			