THE TECHNOLOGY PROGRAMME:
NOVEMBER 2004 COMPETITION FOR FUNDING

Smart Materials and Related Structures

Summary

Smart Materials represent an enabling technology that has applications across a wide range of sectors including construction, transportation, agriculture, food and packaging, healthcare, sport and leisure, white goods, energy and environment, space, and defence. Smart Materials are materials that sense their environment and respond.

In recognition of the importance of this technology, an indicative £7m of funding has been allocated in this competition for Collaborative Research and Development projects in the following application areas:

- Modern Built-Environment
- Environmentally Friendly Transport
- Sustainable Production and Consumption

Background

Smart Materials are materials that respond to environmental stimuli, such as temperature, moisture, pH, or electric and magnetic fields. For example, photochromic materials that change colour in response to light; shape memory alloys and polymers which change/recover their shape in response to heat and electro- and magneto-rheological fluids that change viscosity in response to electric or magnetic stimuli. Smart Materials can be used directly to make smart systems or structures or embedded in structures whose inherent properties can be changed to meet high value-added performance needs.

Smart Materials technology is relatively new to the economy and has a strong innovative content that if well supported can truly create high value-added opportunities for UK. According to work by the Materials Foresight Panel, the use of smart materials could make a significant impact in many market sectors. In the food industry, smart labels and tags could be used in the implementation of traceability protocols to improve

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SUCCEEDING THROUGH INNOVATION

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food quality and safety e.g. using thermochromic ink to monitor temperature history. In motorsport, where the UK is a world-leader, the innovative use of smart materials, such as electro-rheological fluids in active suspension systems, can help maintain this position and provide improvements which will eventually flow down into mainstream automotive applications. In construction, smart materials and systems could be used in 'smart' buildings, for environmental control, security and structural health monitoring e.g. strain measurement in bridges using embedded fibre optic sensors. Magneto-rheological fluids have been used to damp cable-stayed bridges and reduce the effects of earthquakes. In aerospace, smart materials could find applications in 'smart wings', health and usage monitoring systems (HUMS), and active vibration control in helicopter blades. In marine and rail transport, possibilities include strain monitoring using embedded fibre optic sensors. Smart textiles are also finding applications in sportswear that could be developed for everyday wear and for health and safety purposes.

Scope for Applications

In this competition, in each of the application areas described above, two broad areas of technology are included:

- Smart Thin Film Coatings, e.g. electrochromic coatings for energy efficiency measures in the modern built environment
- Smart Structures, e.g. structures, with integrated sensors and actuator materials, which might eliminate the need for heavy mechanical actuation systems or damping systems through their functionality for shape change or vibration control

Smart Thin Film Coatings

Proposals are particularly welcome in technologies that offer:

- Lightweighting, particularly for transport applications, e.g. smart coatings that are able to modify their properties in response to wear or corrosive environments; to improve corrosion and tribological properties of critical components
- Self-monitoring, Control and Self-repair, e.g. applications of functionally graded layers capable of a response tailored to their environment. This will involve use of sensor and actuator technologies for automatic control of conditions within buildings for comfort and energy savings, tagging for food packaging and for crime prevention
- Environment and sustainability, e.g. smart surfaces which offer materials savings, hygiene and safety, and environmental benefits in numerous applications; through increased service life, reduced process emissions and energy consumption, safe and healthy working environment and improved recyclability of waste

Smart coating technologies for both hard and flexible substrates will be considered. Manufacturing technologies that allow cost-effective application of smart coatings will also be considered.

Smart Structures

Key areas of focus for the development of smart structures to include:

- Miniaturisation and integration of components, e.g. application of sensors or smart materials in components
- Robustness of the smart system, e.g. interfacial issues relating to external connections to smart structures

- Device fabrication and manufacturability, e.g. electro-rheological fluids in active suspension systems, applications in telematics and traffic management
- Structural health monitoring, control and lifetime extension (including self-repair) of structures operating in hostile environments, e.g. vibration control in Aerospace and Construction applications. Thermal management of high temperature turbines for power generation. Self-monitoring, self-repairing, low maintenance structures, e.g. bridges and rail track

Smart structures that can self-monitor internal stresses, strains, creep, corrosion and wear would deliver significant benefits. Projects can be based on any material format (e.g. speciality polymers, fibres and textiles, coatings, adhesives, composites, metals, and inorganic materials), which incorporate sensors or active functional materials such as: piezoelectrics, photochromics, thermochromics, electro and magneto rheological fluids, shape memory alloys, aeroelastic-tailored and other auxetic materials.

Project Details

Industry-led proposals that address the above areas are sought for Collaborative R&D projects that involve science-to-business and business-to-business interactions. Projects can range from small, highly focused basic research projects, aimed at establishing technical feasibility, though to applied research, and to experimental development projects configured to produce technology demonstrators. In particular we would encourage projects that can demonstrate benefits to a number of business sectors, and ideally should include at least one partner with defined end-user needs.

Typically a project would have 1-3 year duration and require DTI support of up to £1m, although larger innovative projects will be considered. Projects will generally aim to implement significant business change in a 5-7 year time frame, rather than offer immediate payback.

Other Funding Opportunities

EPSRC are interested in co-funding projects in this technology area where there is a significant high quality academic component. Applicants who wish to seek EPSRC funding should read the additional guidance provided at **www.dti.gov.uk/technologyprogramme**

Contact

If you have any queries about this technology area, please contact Robert Quarshie at the DTI.

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For general enquiries on the application process please contact the helpline on **01355 272155** or e-mail **info@technologyprogramme.org.uk**

Deadline for registering your intention to submit an application: 31st January 2005

Outline application submission deadline: 7th February 2005

For details on how to register and apply go to **www.dti.gov.uk/technologyprogramme**

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