MAKING A DIFFERENCE WITH MATERIALS

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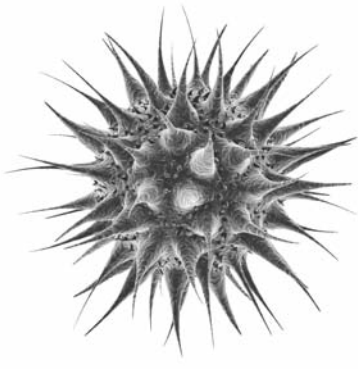
The UK is home to a number of world-class companies whose success depends on their development and use of advanced materials. Fortunately, the UK is recognised for its world-class understanding of materials and when this is combined with the country's excellent design capability, these world-class companies would agree that the UK is the best place to do business in materials. Examples of advances in materials technology include the use of advanced composites in aircraft and racing cars to reduce weight, reduce emissions and lower fuel bills. The UK has developed new ways of designing lighter power modules through smart choices of materials. The increasing use of smart materials for healthcare, sports applications and the fashion industry has catapulted the UK to become one of the top nations in the world for design and innovation.

A major challenge for the UK is to ensure that there is an ongoing investment in materials science and technology to support the much needed innovation and wealth creation by UK businesses. Making choices between different technologies is both challenging and complex. The Materials Knowledge Transfer Network (Materials KTN) and the Technology Strategy Board, through the implementation of its Advanced Materials Strategy, have been helping UK companies and researchers choose wisely.

RECYCLING AND URBAN MINING

Climate change, energy generation and efficient usage, materials security, waste reuse and recycling are all at the forefront of most nations' strategic plans – and, increasingly, consumers' minds. Materials advances are at the heart of solutions enabling, for example, the effective end-of-life deconstruction of structures and the recycling and reuse of product waste. Everyone is familiar with the environmental pressure to reduce waste by recycling, but another factor is the preservation of materials that may become scarce or expensive. Supply shortage is a good reason for recovering materials. Materials security means making sure you have the materials needed to build the item that has been designed. It means maximising recycling and recovery, improving anti-theft measures, substituting for more readily-available materials where possible, but more importantly ensuring supply. In an economy fuelled by materials, we need to be sure that we can get these and keep them for a very long time. This depends on where you source the material, what you do with it when it finishes one life, and how it comes back and has another life. Security is about materials flow. There are good processes available to segregate product waste, reuse and recovery of good materials from old landfill. The pressure is on to 'design out landfill'. A House of Lords report suggested that up to 80% of a product's environmental impact could be eliminated through better design. A big factor is avoiding the waste of raw materials and the energy required for production and disassembly.



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MATERIALS FOR ENERGY HARVESTING

Large-scale energy crises have often troubled modern society, but a huge amount of low-intensity energy is available throughout the environment if it can only be harvested and used. Many small-and-numerous sources go largely ignored. For example, advanced crystals in a road generate power when they are compressed by vehicles passing over them. Advanced materials are often key, and promise the availability of devices which may have maintenance-free lives of hundreds of years, deriving power from the environment in which they operate.

This source of energy includes photovoltaics (power from light), thermoelectrics (power from heat), piezoelectrics (power from pressure) and electrodynamics (power from movement). In many cases energy harvesting and storage depends on materials capability and cost. We have to make sure that the cost of the materials is low enough to do these things. That is where materials science comes in. The aim of development is to reduce costs, make installation easy and the result robust.

MATERIALS FOR HEALTHCARE AND PREVENTION OF MRSA

There are new materials available to meet the growing need for biomaterials and biomarkers to manage and monitor serious clinical conditions. In hospital environments where MRSA and C. difficile are particular problems, the application of new and old materials with innovative designs can reduce the risk of contracting hospital-borne infections, which can be fatal. Technical textiles with antimicrobials have been developed to control the spread of MRSA in hospitals.

In areas where cleaning alone cannot solve the problem such as in awkward corners and joints, advanced combinations of new and traditional materials can, for example, rotational or injection moulding of polymers enables many hospital items, such as bedside cabinets, to have rounded inner corners and few joints to allow easy and effective cleaning. Silver-impregnated dressings used by the NHS cut wound infections and aid healing. Nanocrystalline silver is used in which the material is manipulated at the nano scale so that its surface area, and therefore effectiveness, is much increased. Copper is reported to kill 99.9% of bacteria within two hours of exposure. Trials in the UK and elsewhere with items such as taps, push blades and lavatory seats showed that they had over 90% fewer micro-organisms on them, compared with using chrome-plated brass, aluminium or soft plastic.

MATERIALS FOR SPORTS AND DANCE

How often when watching Wimbledon have we heard the umpire call, 'New balls, please'? This is because as the rubber warms up, it begins to leak air. Nanomaterials can be used to coat the balls to prevent the leakage, as the vast surface area of nanomaterial makes the air's route out of the ball much longer. The use of smart materials in tennis does not end here. Professional tennis players use rackets, which have carbon nanotubes to make them extremely light and durable.

Materials are also helping elite athletes tread the fine line between performance success and failure, by helping them get a better understanding of their own limitations and maximising their potential. Leading UK researchers in body sensor networks, biosensor design, sports performance monitoring and equipment design are working hard to position the UK at the forefront of sensing, both on- and off-body, in elite sports. This has become a reality with the advances in sensor design, integration of smart materials and ultra-low power micro-processor and wireless technologies.

Some advanced materials can be soft and flexible when treated gently, but become stiff and protective on impact. Such materials are ideal for impact protection clothing for sport and other uses, such as the ballet pointe shoe. The life of the professional ballerina has traditionally been a trade-off between grace on stage and excruciating foot pain. The points of traditional shoes are made from an inflexible papier-mâché mixture, which quickly goes from being too tough to disintegrating. With the help of the Materials KTN, a new high-technology shoe has been developed based on a shock-absorbing polymer that hardens on impact to cushion the foot.

The demand for this special polymer came from Olympic athletes' need for flexibility and control, without compromising on protection.

CONNECTING WITH DESIGN, SKILLS AND ATTITUDES

The creative use of advanced materials by product designers is an important contribution to many of the innovations described above. Also, innovating with materials goes much further than supporting and strengthening scientific research and development, a fact demonstrated by the activities of the Materials KTN. Through its initiatives, designed to help accelerate the rate of industrial innovation, the KTN is also helping to equip young people with many vital skills and attitudes for innovation, including problem-solving, curiosity, interrogation skills and multidisciplinary teamwork. The KTN has shown, on many occasions, that when multidisciplinary teams from across materials science, technology, design and the arts tackle a problem together, the solutions they come up with are refreshing and very different to those that emerge from groups of experts in the same field.

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