The sports and leisure sector is becoming increasingly important in society, and with the UK market for sports equipment valued at around £4.2 billion there is real potential for smart materials and systems to take a significant share of the market. Based on the Materials Foresight report ‘Smart materials for the 21st Century’, Dr Chris Bowen provides an overview of how smart materials and systems are making an impact on the sports and leisure area.

The sports sector has always embraced new and novel structural materials such as aluminium alloys, titanium alloys, advanced polymers, glass and carbon composites. These materials are rarely developed by the sports industry and tend to originate from those developed for military, aerospace and transportation applications. A similar pattern is emerging in the field of smart materials whereby piezoelectric fibres and shape memory alloys, developed for other sectors such as medical and aerospace, are being incorporated into sports based equipment – although novel textiles are often developed purely for the leisure market.

Smart materials are often used to construct smart systems and include a wide range of materials such as piezoelectrics, magnetostrictives, shape memory alloys and polymers, thermo and electro-chromic materials, and conductive polymers. The piezoelectric tennis racket manufactured by Head is a good example of a smart system in sport.

Making a racket
Modern rackets have been designed to be stiff to maximise the energy returned to the ball, which results in the racket transmitting large amounts of shock and vibration to a player’s arm.

In an attempt to reduce vibration, piezoelectric fibres, which generate a charge under the application of a force, or develop a strain under an applied electric field, are embedded around the racket throat. When the ball is hit the racket frame deflects slightly, bending the piezoelectric fibres and generating a...
A good example of the use of smart materials in sport – this tennis racket manufactured by Head is embedded with piezoelectric fibres connected to electrodes, which aim to reduce vibration to the player’s arm. (Image: Reproduced from the Materials Foresight report ‘Smart materials for the 21st century’)

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It is not only sports equipment where UK manufacturers are making an impact and taking a market share. SOFISwitch Ltd has developed the use of a pressure sensitive textile that consists of conductive metallic particles covered by a polymer insulator aimed at the sports clothing market, which accounts for almost 50% of the total UK market for sports products. Since the coating is extremely thin, the resistance of the material is sensitive to deformation, allowing it to be used as a switch or pressure sensor. The fabric has enabled electronics, audio devices and mobile phones to interface with clothing, in particular snow sports clothes manufactured by Burton Snowboards, Nike, The North Face and O’Neill.

The increased interest in novel textile materials has led to the development of an EPSRC UK Network initiative on ‘Smart Textiles for Intelligent Consumer Products’, based in the Innovation Centre at Central Saint Martins College of Art and Design, London. A principal aim of the network is to improve the development in smart textiles and systems, with textile users and designers being brought together with materials developers. Workshops are to be held during the three-year period of the network, each of which will cover a specific technology area, including sensors and actuators, display materials, circuits, antennas, and switches.

Overcoming potential barriers
Many of the smart materials discussed are readily and commercially available, driven by a need to:

- improve the performance of existing equipment and add value to the product and increase competitiveness with other manufacturers
- increase the functionality of an existing product, such as the use of conducting or colour changing textiles
- develop new products
- use smart materials as a marketing tool to increase consumer interest.

In addition to the materials, technologies such as active and passive vibration damping are being heavily researched in other sectors such as transport and aerospace.

While the materials and the technologies are clearly available, a potential barrier to the future development and commercial exploitation of new products in this sector is a lack of awareness and understanding of the properties and applications of smart materials by those working in the sports and leisure industry. However, encouragingly while traditional engineering and physical sciences degrees are finding undergraduate and postgraduate recruitment increasingly competitive, degrees in sport and exercise science (which concentrate on human performance), and sports engineering/technology/materials (which concentrate on equipment) are increasing in number. The Engineering and Technology Board is also using a lecture tour based on ‘Engineering in the Olympics’ to generate increased interest in engineering, science and technology across UK schools, so these potential barriers could soon be overcome by the next generation.

Further reading
- The aim of the Materials Foresight report on ‘Smart materials for the 21st Century’ was to carry out a comparative review of the status of smart materials technology, to identify the key drivers and barriers to commercial exploitation, and to recommend a strategy for future UK government funding support. The report considered areas such as aerospace, transportation, consumer packaging, construction, energy, white goods, healthcare and sports & leisure. Further Foresight report details can be found at www.iom3.org/foresight/reports.htm