

MATERIALS

There is outstanding expertise available in the SW, which can bring a multidisciplinary approach to the research and supervision of postgraduate students. Six indicative areas are outlined below. They are topical, offer scientific potential and in the longer term are likely to benefit the economy of the South West.

The key areas might include:

a) Nanoparticles & Nanocomposites

Polymer matrix nanocomposites are among the most important applications of nanomaterials. Use is projected to grow from 1kt in 1999 to >1500kt worldwide by 2009. There is a need to develop 'best in the world' capability in understanding, designing and engineering nanocomposites to deliver outstanding, predictable and reproducible performance.

b) Biomaterials

Key areas for development include: physical and chemical properties of ceramic orthopaedic implants; the design and fabrication on the nano, micro and macro scale of hydroxyapatite bone substitute implants; mechanical and optical properties of a range of biological materials; and polymers, plastics and rubbers for medical applications.

c) Carbons & Graphite

The South West has significant expertise in the many forms of carbon for use in energy applications and in nuclear graphites. We would aim to build on this experience for the development of activated carbons and other graphitic carbons such as nanotubes and nano-fibres for electronic applications, hydrogen storage and battery applications. Gas storage is considered a key aspect of a future hydrogen economy, an essential component of any alternative energy scenario. We also aim to look at engineering graphites and advanced carbons for specific applications. Results from this work will be used to improve understanding of the degradation of synthetic graphites used in the nuclear and metallurgical industries.

d) Joining & Bonding

The joining and bonding of advanced materials is critical for improved performance. Solid state bonding and particularly, diffusion and resistance bonding are becoming increasingly important. On a larger scale, the technology of welding thick sections and particularly the investigation of developed stresses will be of interest to the power generation and transport industries. Coatings of various kinds are used to improve efficiency and cost effectiveness. Thermal barrier coatings in their various forms are being investigated to understand and predict mechanisms of breakdown. Life prediction studies will be undertaken and algorithms developed to predict lifetimes and service intervals for turbines used in aircraft and power stations.

e) Sensors & Actuators.

Sensors and actuators are ubiquitous in advanced technologies. The development of the science technology, and the fabrication into devices is key to electromechanical components and the ensuing commercialisation of machines. Projects might be undertaken in: molecular materials including liquid crystals; functional oxide materials including porous metals; piezoelectric oxides; fibre composites; and photo-activated metal oxides used in water treatment and purification. Cost effective, large scale, manufacture of doped metal oxides could revolutionise drinking and grey water treatment; for example, through development of large water treatment plants. This technology would be of special benefit to polluted wells and bore holes in the Third World or developing European economic areas.

f) High Band Gap Semiconductors & Devices.

Internationally leading expertise exists in the region in the high bandgap semi-conductor technologies based on diamond, SiC and GaN. Leading edge fabrication facilities are available and notable advances have been made in device production. Projects would involve further development of successful laser technologies; investigation of Gallium Nitride (GaN) for applications other than lasers such as sensing and optical signal processing. Both wurzite and cubic crystal structure materials will be studied, to ensure the best materials choice, notably

optimum band gap, for optical signals of wavelength in the whole visible and near infrared parts of the electromagnetic spectrum.

g) High quality proposals in any other area of materials will also be considered

Regional relevance and business partners

The main regional impact of this work will be in the aerospace and advanced engineering industries. This industry accounts for 9.9% of the total employment in the South West and a large proportion of its high tech employment of 129,354 and a large proportion of overall research expenditure. The proposals in this strand are in line with the opportunities identified for further development in the AD Little study of regional strengths compiled in 2003.