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MULTIFUNCTIONAL ADVANCED MATERIALS – THE KEY FOR NEW TECHNOLOGY AREAS. A SHORT OVERWIEV

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Abstract: *The world is changing. Globalization, digital communications and the growth of emerging economies present profound challenges to business sectors. Yet where there are challenges and also opportunities. Open access to global supply networks and emerging markets is easier than ever before.*
The Advanced Materials strategy, identifies those technology themes which will help materials businesses to collaborate and make the transition towards high value activities. The technology-inspired approach focused through key challenge areas and emphasis on the development of high value-added products and processes.
This paper presents the strategy for the key technology area of Multifunctional Advanced Materials.
Keywords: *multifunctional materials, advanced materials, new technologies.*

1. INTRODUCTION

The aim for obtaining multifunctional advanced materials is the strategy that outlines ways in which the materials sector can continue to innovate and grow, for further enhancing its contribution to solving key societal problems and enhancing national wealth creation.
The strategy presents a holistic approach for innovative advanced materials development and application, which aims to provide continuity and commitment in key areas and to support the industry as a provider of high value-added products, processes and services.

2. AREA STRATEGIES

The main scope is for obtain encompasses materials and their associated process technologies, with the potential to be exploited in high value-added products. These are considered within four broad major categories: structural, functional, multifunctional and bio-materials, together with important cross-cutting areas - including nanomaterials, modeling, design, metrology and standards, process technologies and manufacturing.
Three priority areas, based on an analysis of common market sector drivers, are identified as channels for technology inspired activities leading to high added value products and processes with exploitation potential via multiple strong market sectors, (Figure 1).
a. **Energy -** secure, clean and affordable energy supply, distribution and usage;
b. **Sustainability -** focused on transport, construction and the 'reduce, reuse and recycle agenda, including packaging;
c. **High Value Markets -** including technologies for Healthcare, the Creative Industries, and Defence and Security.
The need is recognized for continued investment in underpinning and emerging generic materials technology development and exciting thrust areas are identified which are anticipated to have a major impact in the key challenge areas. These are listed in Figure 2, together with a broad mapping of their likely major impact potential.

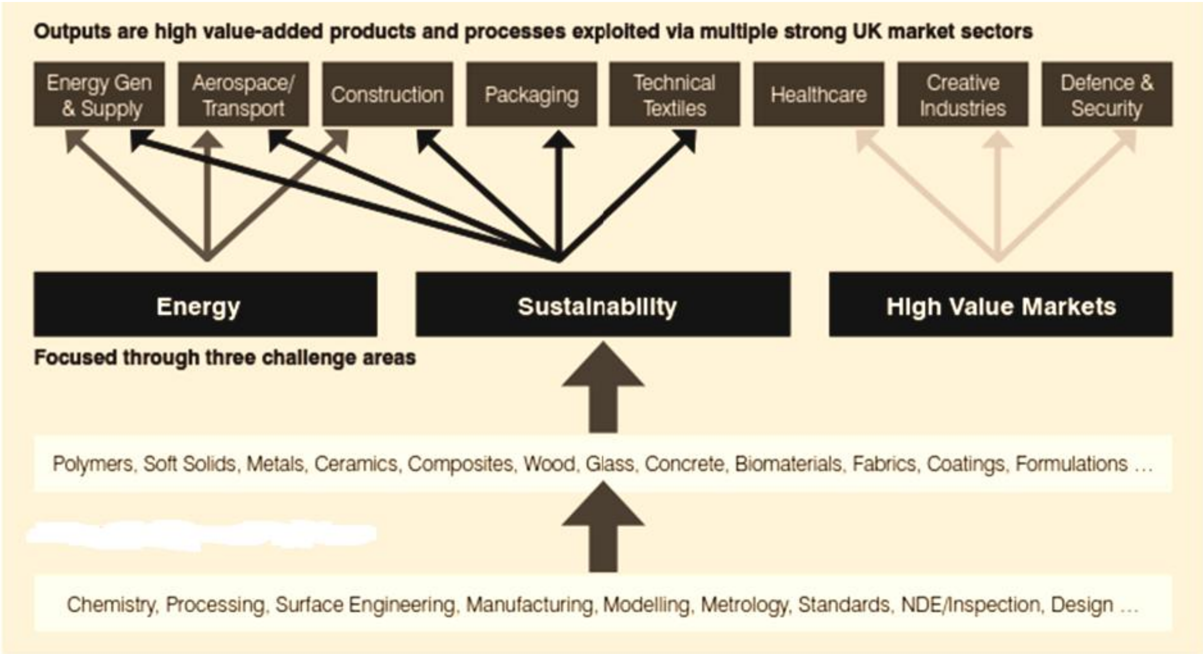

Figure 1. A technology-inspired strategy focused through key challenge areas

	Energy	Sustainability	High Value Markets
Lightweight materials and structures, including composites and hybrids	x	x	x
Materials to withstand more aggressive environments (e.g. high temperature, corrosive, erosive)	x	x	x
Electronic and optical functional materials	x		x
Smart and multifunctional materials, devices and structures	x	x	x
Surface engineering and coating technologies	x	x	x
Particulate engineering; near-net shape manufacturing	x	x	
Fibre and textile-based technologies	x		x
Bioresorbable, bioactive and biocompatible materials			x
Natural and bio-based materials		x	x
Joining technologies	x	x	x
Materials for portable power sources (batteries/fuel cells)	x		x
Nanomaterials	x	x	x
Materials with reduced environmental impact through life		x	
Materials designed for reuse/recycle/remanufacture		x	

Figure 2. Technology thrusts in each of the key challenge areas

Strong stakeholder co-ordination and multidisciplinary collaboration is proposed, in order to facilitate the effective delivery of the strategy.

In the next years the Technology Strategy Board will:

✓ invest in materials technologies which address the key challenges of energy and the environment;
✓ invest in materials technologies focused on the 'reduce, reuse and recycle' sustainability agenda;
✓ continue to invest in materials for high value markets, including healthcare, the creative industries and defence and security;
✓ work with other government and industry stakeholders to identify opportunities for joint or aligned activities; including generic underpinning R&D and proof-ofconcept studies;
✓ work with other stakeholders in respect of metrology and standards development;
✓ support an innovation culture via, for example, the use of Knowledge Transfer Partnerships (KTP) and Knowledge Transfer Networks (KTN);

✓ seek, with other stakeholders, to identify European and other international strategic alignment and financial gearing opportunities in support of improved projekts for competitiveness and inward investment [1 – 5].

3. MATERIALS CONTEXT

Advanced Materials, defined here as multifunctional materials and their associated process technologies, with the potential to be exploited in high value-added products, is both a multidisciplinary area within itself (including, for example, physics, chemistry, applied mathematics) and cross-cutting over both technology areas (e.g. electronics and photonics, biosciences) and market sectors (e.g. energy, transport, healthcare, packaging).
Consequently, defining a core strategy for advanced materials technology is complex: it must take into account, and be consistent with, the major drivers and strategies of these related areas.
It must also take into account a range of Technology Readiness Levels (TRL) and identify appropriate mechanisms to deal with these [6].
It encompasses the full life cycle; from materials extraction, primary production, process development and materials characterization, through product fabrication, testing and use, to end-of-life waste management and recycling.
Supporting activities include research, design and development, together with skills and standards development. There are also strong crossovers with the chemistry sector in respect of, for example, soft solids and formulations, and the role of upstream chemistry in the design and manufacture of materials.
The strategy for creating the way from raw materials to finished products, must follow a holistic strategy for innovative advanced materials development and application which aims to provide continuity and commitment in key areas and to support of high value-added products, processes and services.

4. TECHNOLOGY OVERWIEV

Advanced Materials can be subdivided conveniently into four broad major categories [7]:
✓ Structural
✓ Functional
✓ Multifunctional
✓ Biomaterials.
together with important cross-cutting and underpinning themes:
➢ Nanomaterials [8]
➢ Modeling
➢ Design
➢ Metrology and Standards
➢ Process Technologies
➢ Manufacturing [9].
In particular, a number of individual technology areas can be identified which have broad material, product and market applicability and represent specific technological thrust areas. These include:
- lightweight materials and structures, including composites and hybrids;
- materials to withstand more aggressive environments (e.g. high temperature, corrosive, erosive);
- electronic and optical functional materials;
- smart and multifunctional materials, devices and structures;
- surface engineering and coating technologies;
- particulate engineering; near-net shape manufacturing;
- fibre and textile-based technologies;
- bioresorbable, bioactive and biocompatible materials;
- natural and bio-based materials;
- joining technologies;
- materials for portable power sources (batteries/fuel cells);
- materials with reduced environmental impact through life;
- materials designed for reuse/recycle/remanufacture;
- predictive modelling through the full life cycle, including lifetime prediction.

The Advanced Materials area also encompasses technologies, from the conceptual development stage of, for example, nature-inspired (biomimetic) materials, to the everyday use of metal, plastic, ceramic and bio-based products.

It represents an underpinning technology platform, with many crossovers into other technical areas and with the potential to address challenges across a broad applications landscape.

5. INDUSTRY OVERWIEV

Businesses in the UK that produce, process, fabricate and recycle materials (Figure 3) have an annual turnover of around L170 billion. They contribute about 15% of UK GDP, with a gross value-added (GVA) of around L60 billion and form an important element in the supply chain of many high value manufacturing businesses. Raw materials supply, primary production and processing represent a combined GVA of around L25 billion, with fabrication around L35 billion [10].
Recycling represents an important opportunity for high value-added growth.

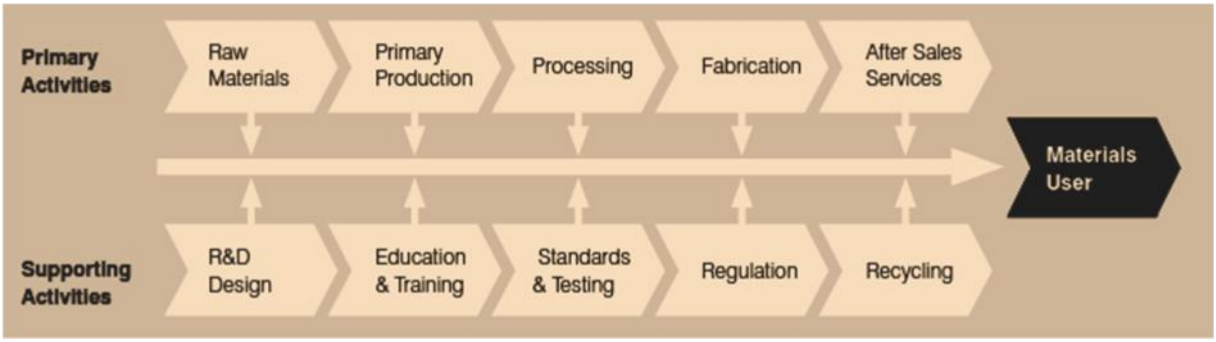

Figure 3. The advanced materials value chain

The definition of the materials sector in this way, acknowledges the ongoing shift from the UK being a supplier-centered industry to a customer-centered industry. Instead of being viewed as just commodities, materials are being engineered to enhance performance and to reduce life cycle costs.
The competitive position of materials suppliers is increasingly dependent on their ability to supply materials with pre-engineered functionalities, tailored to end-user applications.
The co-ordinated approach will help to facilitate the faster exploitation of more innovative technologies by the phasing and gearing of investment across the entire TRL range of the product development lifecycle.
The benefits offered by international collaboration; e.g. via EU programmes, both in terms of financial gearing and access to research and industrial supply chain capability in support of business, will also be explored.
A major concern within the materials sector is the need for further 'proof-ofconcept' projects, which are often required to help to facilitate and de-risk the transfer of technology between either the academic laboratory and more applied research, or prior to specific product development by industry.
Further consideration is required, with other stakeholders, regarding the inclusion of such activities as part of the overall product development investment cycle.

REFERENCES

[1]. A Strategy for Materials – DTI/Pub8134/1.0k/03/06/NP; 2006. www.matuk.co.uk/docs/DTI_mat_bro.pdf
[2]. The Race to the Top – A Review of Government's Science and Innovation Policies; October 2007.
[3]. Strategic Decision Making for Technology Policy – Council for Science and Technology; 2007
[4]. www.materialsktn.net
[5]. www.matuk.co.uk
[6]. NASA – http://www.hq.nasa.gov/office/codeq/trl/trl.pdf.
[7]. Materials IGT S&T Report, 2006 – www.matuk.co.uk/docs/ScienceTech.pdf.
[8]. Technology Strategy Board – Nanotechnology Strategy.
[9]. Technology Strategy Board – High Value Manufacturing Strategy BERR, 2008.
[10]. Technology Strategy Board – Environmental Sustainability Strategy UK Energy White Paper, May 2007
[11]. Advisory Council for Aeronautics Research in Europe (ACARE) 2020 Vision. http://ec.europa.eu/research/transport/transport_modes/aeronautics.en.cfm.