

PHYSICAL SCIENCES PROGRAMME

programme remit

The Physical Sciences programme remit encompasses a wide range of scientific areas including, but not exclusively: organic and inorganic chemical synthesis; physical, analytical and biological chemistry; synthesis and characterisation of materials and materials modelling at the atomic scale; atomic, molecular, optical and plasma physics; condensed matter physics; lasers, optics and surface science. Many of these areas are collaborative across the programme.

programme strategy

The current priorities for the Physical Sciences Programme are:

- Supporting a high quality investigator-led research portfolio through:
 - Standard research grants including first grants, networks, overseas travel grants, etc
 - Longer larger grants to support key research leaders
 - Signposting in topical areas to strengthen the UK capacity
 - Funding international partnerships.
- Promoting multidisciplinary research that builds upon and stretches core disciplines
- Supporting researchers at pivotal points in their career through Fellowships
- Encouraging more researchers to access EPSRC-supported facilities to enable them to maximise their research outputs.

Research, societal and economic impact

The true overall societal and economic impact of the current research funded via the Physical Sciences Programme will not be felt for many years to come. Historically underpinning chemistry, materials, and physics research has already had significant impact upon areas such as energy (e.g. photovoltaics), drug discovery (e.g. synthetic chemistry and chemical biology), information and communication technologies (e.g. optics and optoelectronics) and healthcare (e.g. new materials for drug delivery).

Much of the research funded is of a fundamental nature and user-collaboration on EPSRC grants in the physical sciences is variable – 17% of projects funded through the Programme have user-organisations as project partners.

Strategic partnerships formed by the EPSRC with businesses (e.g. GSK, Pfizer) in the pharmaceutical sector are enabling a more rapid take-up of novel research (products and processes) by users. GSK, Pfizer and AZ alone are currently project partners on 66 EPSRC projects and provide cash contributions exceeding £2.5M. More importantly these partnerships also allow industry to influence the training of PhD students who in turn can develop new skills that industry would not otherwise have access to e.g. via Industrial Doctoral Training Centres and Industrial CASE training. A recent strategic partnership signed between EPSRC and the National Physical Laboratory (NPL) should also provide researchers in the physical sciences with more opportunities for knowledge exchange. Better two-way communication between EPSRC and the physical sciences research community should enable greater knowledge exchange to identify research and skills needs and maximise the opportunities available to address the broader challenges facing the UK.



International links

Current international activities include:

- Joint-funding projects with NSF in the US through the International Collaboration in Chemistry programme and the Materials World Network
- Working with the National Science Foundation of China (NSFC) to joint-fund research in the area of nanospintronics. A joint workshop was held in December 2008 in London with 13 Chinese and 25 UK academics in attendance. A joint call for proposals was announced at the workshop, with £2M from EPSRC and matched funds from NSFC for collaborative projects lasting approximately 3 years
- A joint call for proposals in the area of Oxide Electronics, Organic Electronics and Spintronics with the Japanese Science and Technology Agency, which was issued in May 2008. It is likely that further call in this area will be issued in future
- Interactions with European Science Foundation
 - EUROCORES: 4 Collaborative research projects (CRPs) in 'Fundamental nanoscale phenomena affecting electron transport', 4 CRPs in 'Cold quantum matter' and 1CRP in 'Quantum standards and metrology' (total commitment £4.07m)
 - 8 Research Networking Programmes (€710k over 5 years).



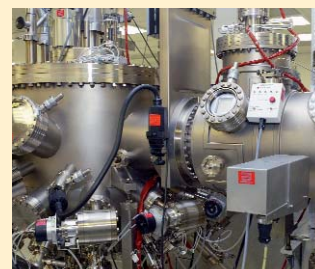
Public engagement

It is our perception that much of the physical sciences community is involved in public engagement, with several Partnerships for Public Engagement (PPE) awards and two Senior Media Fellows – Jim Al-Khalili and Andrea Sella. There are also opportunities for researchers to work with their learned societies in this area. However, many researchers do not place sufficient consideration on the social relevance, impact or ethical issues associated when scoping their research. Activities with young people or schools can often be related to the fundamentals of science rather than contemporary research in order to fit in with the STEM curriculum; however, some projects have successfully engaged a wide range of audiences using current research. A few researchers have had great success at embedding engagement within their institution, such as Colin Pulham (Edinburgh), Tony Ryan (Sheffield) and Martin Poliakoff (Nottingham).

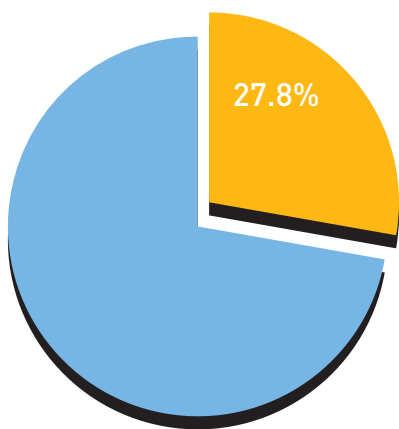


Major facilities and infrastructure

The Physical Sciences Programme currently funds a number of meso-scale characterisation facilities that are exploited by the chemistry, materials and physics research communities (e.g. EPSRC National Mass Spectrometry Service, Solid-State NMR research service, National Centre for Electron Surface Spectroscopy, Medium Energy Ion Scattering facility, SuperSTEM, XMaS, III-V semiconductor facility, RAPRA Smithers polymerisation characterisation services, National service for electron paramagnetic Resonance, National Crystallography Service, Laser Loan Pool Facility etc.). The Programme also funds a number of research grants that make use of larger scale facilities such as HECToR, Diamond and ISIS, and these are further complimented with access to international facilities at ESRF and ILL. Access to world-class facilities is crucial in order to sustain a successful UK physical sciences research base in the future. However, as identified in the programme strategy, utilisation of facilities by the physical sciences community would be welcomed.



Programme % of total EPSRC budget

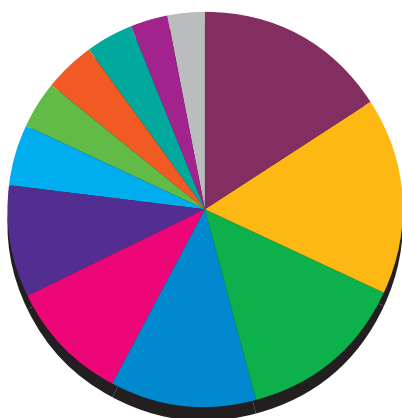


Inter-relation with other EPSRC programmes

Programmes	Level of interaction
Maths	✓
ICT	✓✓
M3E	✓✓
PES	✓✓
Cross-Disciplinary Interfaces	✓✓✓
Energy	✓
Healthcare	✓
Digital Economy	
Nanoscience	✓✓✓
Cross Council	✓

There is also significant joint-working and joint-funding in responsive mode between EPSRC and BBSRC in the physical sciences. For example, BBSRC is currently providing approx. £10M of joint-funding on EPSRC grants funded through the Physical Sciences Programme. The Cross-Disciplinary interface programme (C-DIP) manages the interface between EPSRC programmes and the other Research Councils – initiatives such as the Physics-Life Sciences interface signpost aim to bridge the gap between disciplines covered in the two programmes.

Subthemes by % value of programme



Please click the links below to view the subtheme pages.

- Superconducting, magnetic and photonic materials 16%
- Synthetic chemistry 16%
- Physical chemistry 14%
- Condensed matter physics 12%
- Plasmas, lasers and optics 10%
- Atomic, molecular and optical physics 9%
- Catalysis 5%
- Analytical sciences 4%
- Functional materials 4%
- Structural polymers 4%
- Surface science 3%
- Structural ceramics and inorganics 3%

Questions for discussion

- What are the three most significant research challenges facing the physical sciences community over the next 10-15 years?
- What role can physical sciences play in tackling major global societal challenges? e.g. energy (affordability, production, storage and distribution), sustainable resources, personalised healthcare, etc.
- What can EPSRC do to foster links between disciplines within the physical sciences and links with other disciplines e.g. life sciences?
- What could the Physical Sciences Programme do to improve communication with researchers in the physical sciences?

Please e-mail your views and suggestions to PhysicalSciences@epsrc.ac.uk. We will endeavour to acknowledge your message within two days of receipt and we will provide feedback within a reasonable time.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk



PHYSICAL SCIENCES PROGRAMME

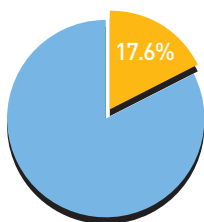
Superconducting, magnetic and photonic materials

At a glance

This sub-theme deals with fundamental and applied research into the synthesis, characterisation and understanding of the properties of novel superconductor materials (e.g. MgB₂, cuprates), magnetic materials (e.g. Fe₂O₃) and photonic materials (e.g. GaN). It incorporates a significant proportion of research into spintronics but excludes the area of molecular electronics.

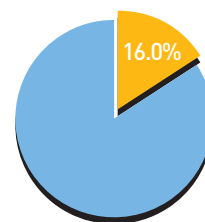
Grants funded

285
17.6% of Programme



Grants value

£115.5M
16.0% of Programme



Greatest cross sub-theme connectivity

- Functional Materials (Physical Sciences)
- Condensed Matter Physics (Physical Sciences)
- Photonic Materials and Devices (ICT)



Greatest user collaboration

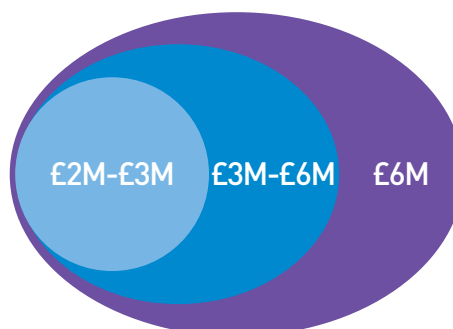
- DSTL
 - Hitachi
 - Seagate Technology
 - Powerwave UK Ltd
- There is significant investment from companies e.g. Seagate directly into universities which is not captured here.

Leading centres based on EPSRC funding

- Cambridge – Gallium Nitride Group, Device Materials Group, Nanoscale Science, Nanophotonics group
- Imperial – Experimental Solid-state Physics Group
- Manchester – Electronic Information Storage Systems group, Photon Science Institute
- Sheffield – Centre for Advanced Magnetic Materials and Devices, EPSRC III-V centre
- Southampton – Nanophotonics group

Universities within sub theme by EPSRC funding

Bristol	UCL	Cambridge
Warwick	St Andrews	Sheffield
QUB	Leeds	Imperial
Surrey	Birmingham	Manchester
York	Durham	Oxford
Nottingham	Southampton	



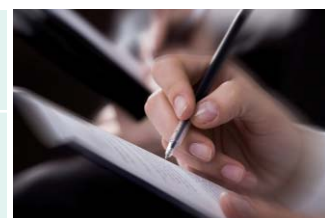
Research capability

Centres for doctoral training

University	Name of centre
Imperial	Theory and Simulation of Materials DTC
UCL	Molecular modelling and materials science IDTC
Cambridge	Assembly of functional nanomaterials and nanodevices DTC
Manchester	Northwest Nanoscience DTC

PhD and postdoc fellows

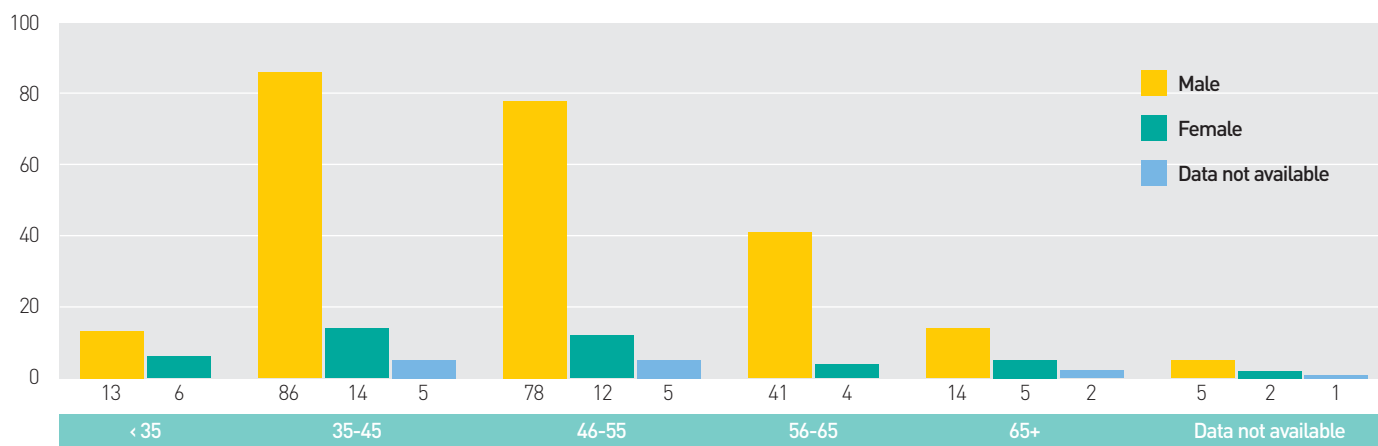
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
300 3.4% of EPSRC total	N/A



Fellowships

Advanced research fellows		Number: 9	Total: 4.1%
Dr T Wang – Sheffield	Dr JH Durrell – Cambridge	Dr SK Clowes – Surrey	Dr SA Lynch – UCL
Dr W Kruglyak – Exeter	Dr AJ Cadby – Sheffield	Dr G Burnell – Leeds	Dr AP Hibbins – Exeter
Dr DA Allwood – Sheffield			
Career acceleration fellows		Number: 2	Total: 8.7%
VA Fedotov – Southampton	A Kolmogorov – Oxford		

Demographics



Based on principal and co-investigators

Swot analysis

Strengths

- High number of world-class well-funded UK research groups. Significant number of EPSRC fellowships in these areas
- Great market opportunities in magnetic and superconducting materials e.g. data storage, medical imaging and other instrumentation
- New materials for global lighting applications – real low-carbon lighting alternative
- Modelling and simulation
- Theoretical materials science.

Weaknesses

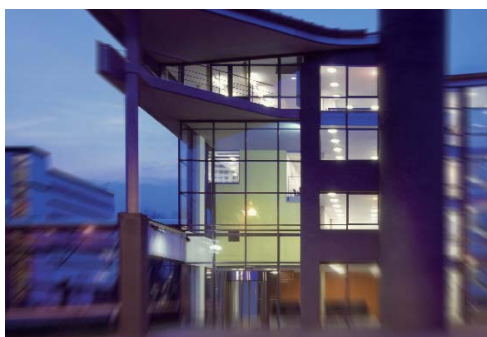
- Absence of long-term coordinated vision for the UK research communities (e.g. nitride-based materials, magnetic materials)
- Supply of high-quality graduates, especially those originating from the UK
- Level of industry collaboration is patchy in certain areas (e.g. superconducting materials) due to absence of significant UK company base. Inability to exploit relevant research as a result.

Opportunities

- Some level of strategic alignment between top UK groups within the sub-theme and government priorities (e.g. energy, low-carbon economy) could help making the case for long-term sustained investment in the research base
- Spintronics as potentially disruptive technology
- Metamaterials for next generation optics
- New applications of superconducting materials e.g. improving reliability of power networks
- Longer-larger EPSRC investments should help build and sustain capacity for the most outstanding groups.

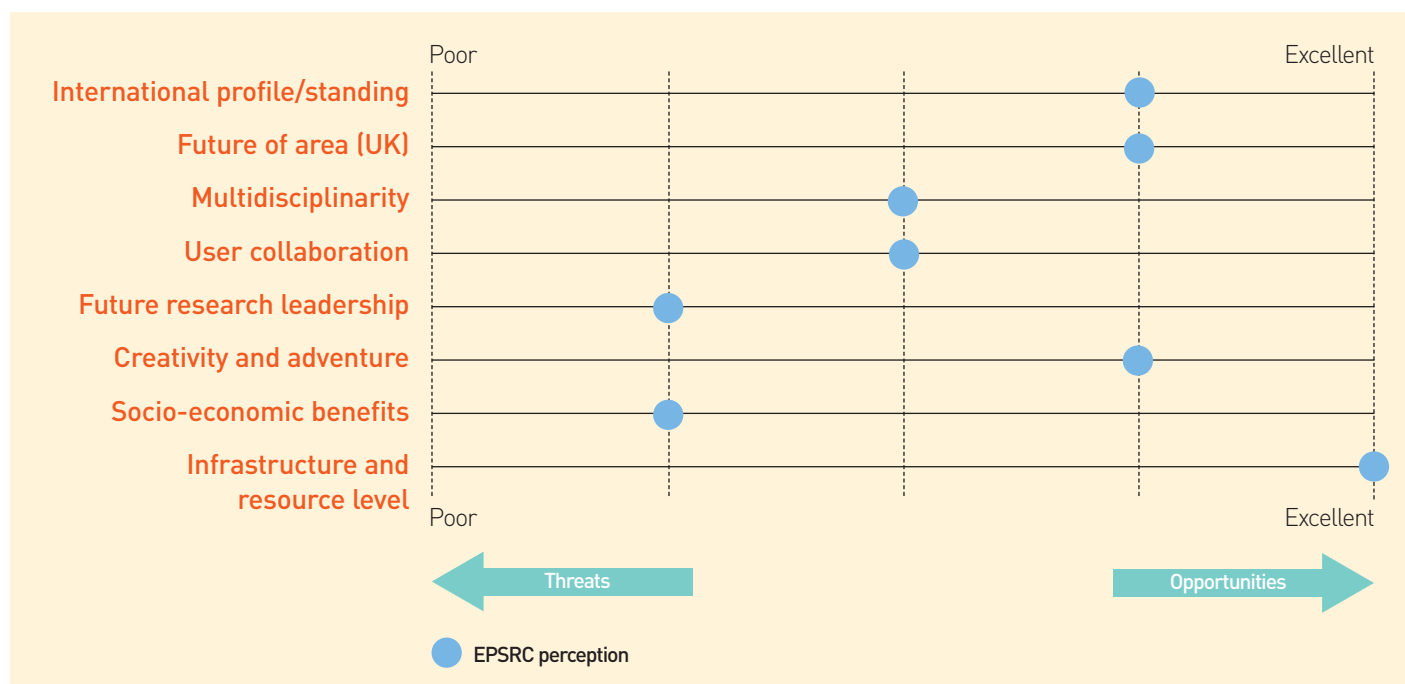
Threats

- Low number of first grants – this may impact leadership for the area in the future
- Economic downturn may force collaborating companies to reduce their level investment in university research groups. This is particularly true for this sub-theme as companies based in the UK tend to be SMEs
- Struggling materials manufacturing industrial base – additional investment in innovative high-value materials may help reinvigorate the area.



Perceptions

Our perception of the current position of UK superconducting, magnetic and photonic materials research



Summary

This sub-theme is really comprised of two somewhat related areas (superconducting and magnetic materials) and one separate altogether (photonic materials excluding organic electronics).

Superconducting materials have shown much promise over the last 20 years and the UK remains competitive in the area, with particularly strong activities in the physics of superconductivity. The area of magnetic materials has produced numerous examples of excellent academia-industry knowledge exchange (e.g. magnetic storage) and significant international collaborations. Spintronics, although it has yet to deliver all its promise into next generation computing hardware devices, is a potentially disruptive technology and the UK academic community has a number of key world-leading groups, backed by industrial support (e.g. Seagate, Hitachi, Toshiba, Qinetiq). Photonic materials has been a particular UK strength ever since the early 80s and the development of optical fibre technologies. New advances into Metamaterials for next generation optics and novel inorganic semiconductor materials for light-emitting applications helping to deliver a low-carbon economy are two examples where the UK is world-leading.

Specific recent EPSRC initiatives with China and Japan (spintronics) and with the US (Materials World Network) have helped UK groups to collaborate with the best research groups worldwide. Multi-disciplinary research with the life sciences has accelerated over the past five years but much more has yet to be achieved. Opportunities exist in sustaining long-term leadership for the three areas and ensuring that exciting new technologies developed in the UK can be exploited successfully and benefit the country's economy in the long term. A particular focus on high-value innovative materials may help to achieve this despite the current economic downturn. This will only be achieved via building effective partnership between the relevant academic groups, the research funders and the industry. Overall the sub-theme is currently well resourced.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

PHYSICAL SCIENCES PROGRAMME

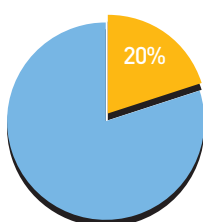
Synthetic chemistry

At a glance

The synthetic chemistry theme encompasses areas of both organic and inorganic synthesis in asymmetric chemistry, carbohydrate chemistry, chemical synthetic methodology, combinatorial chemistry and co-ordination chemistry. It also covers work in organometallic synthesis and the use of fundamental techniques to synthesise and study biologically active molecules. This does not include information incorporated into the materials and nanotechnology portfolio reviews.

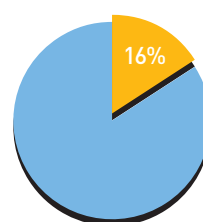
Grants funded

323
20% of Programme



Grants value

£122M
16% of Programme



Greatest cross sub-theme connectivity

Fundamental Biology (C-DIP)
Process Engineering (Process, Environment and Sustainability)
Structural Polymers



Greatest user collaboration*

GlaxoSmithKline
Pfizer
Procter and Gamble
AstraZeneca
Novartis
Syngenta

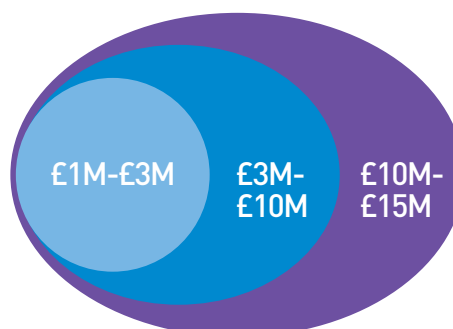
* Whilst there is some evidence to suggest that direct contributions from pharma may be decreasing, EPSRC maintains good links with these companies. These strong links, in the form of strategic partnerships have led to a number of joint calls including the Flow Chemistry call and the recent Organic Synthesis Studentships, for which a fourth round is scheduled to be run this year.

Leading centres based on EPSRC funding

- Cambridge – Synthetic and Mechanistic Chemistry Group
- Oxford – Organic Chemistry Group
- Imperial – Synthesis Group
- Nottingham – Organic and Biological Chemistry Group
- Bristol – Organic and Biological Chemistry Group

Universities within sub theme by EPSRC funding

Durham	Manchester	York	Bristol
Newcastle	Nottingham	Strathclyde	Cambridge
Liverpool	Imperial	Sheffield	Oxford
St. Andrews	Bath	Warwick	
Cardiff	Edinburgh	UCL	
Swansea	Leeds	Southampton	
	Birmingham	Glasgow	




Centres for doctoral training

University	Name of centre
Bristol	Chemical Synthesis DTC
Bath	Sustainable Chemical Technologies IDTC

PhD and postdoc fellows

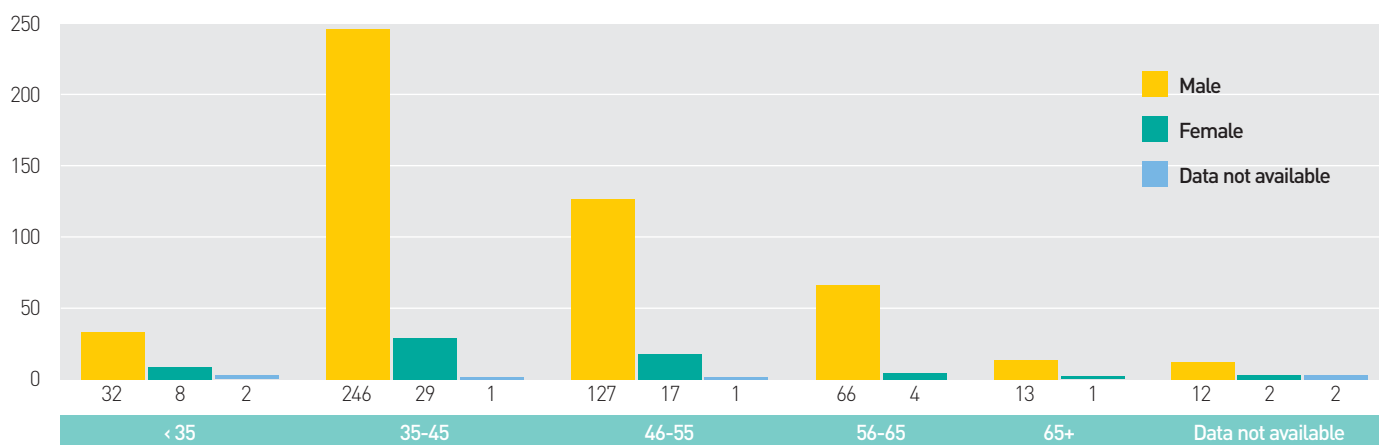
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
585 6.7% of EPSRC total	3



Fellowships

Advanced research fellows	Number: 10	Total: 4.7%	
Dr D Spring – Cambridge	Dr M Willis – Oxford	Dr RA Stockman – Nottingham	Dr JA Weinstein – Sheffield
Dr EA Anderson – Oxford	Dr D Fox – Warwick	Dr GA Burley – Leicester	Dr RS Grainger – Birmingham
Dr NCO Tomkinson – Cardiff	Dr P Portius – Sheffield		
Senior research fellows	Number: 2	Total: 8.7%	
Prof V Aggarwal – Bristol	Prof D Leigh – Edinburgh		
Career acceleration fellows	Number: 2	Total: 8.7%	
Dr L Higham – Newcastle	Dr L Natrajan – Manchester		
Leadership fellows	Number: 3	Total: 13.0%	
Dr D Dixon – Oxford	Dr M Greaney – Edinburgh	Dr J Tucker – Birmingham	

Demographics



Based on principal and co-investigators

Synthetic chemistry

Swot analysis

Strengths

- Future looks to have firm foundations with significant number of young academics in lots of strong departments
- Substantial amounts of adventurous research at the life sciences interface, tackling important problems in biology and medicine
- A good number of world leaders based in the UK.
- Good links to pharma – a number of strategic partnerships.

Weaknesses

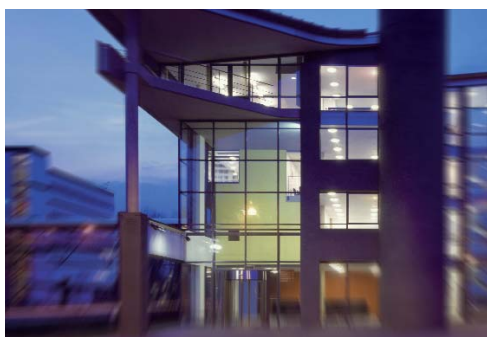
- Proportionally small number of women staying in research compared to the EPSRC average
- Synthetic chemists have tended to request smaller research grants more frequently which may make the transition to more, longer larger grants more difficult
- Little interaction with non-pharma industry within the EPSRC portfolio.

Opportunities

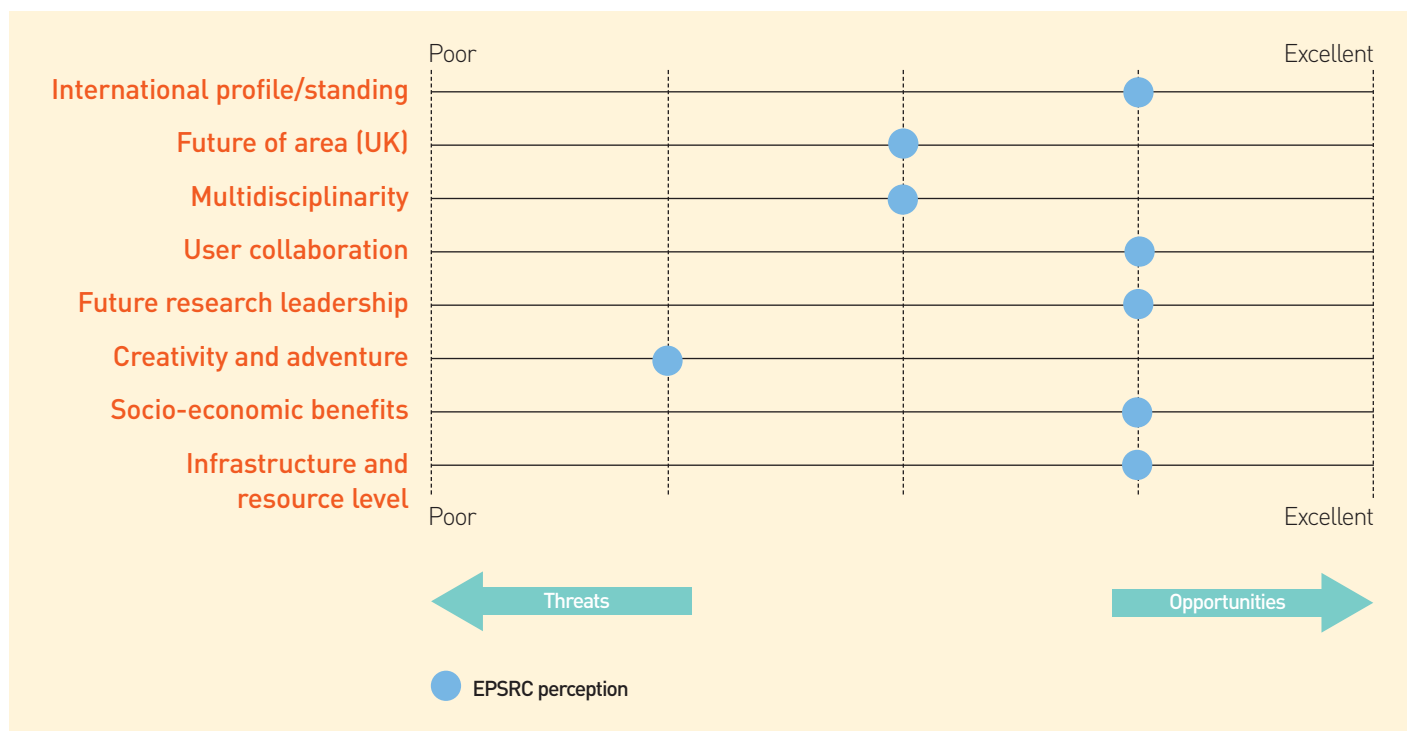
- Opportunities to form partnerships with overseas academics – Chemistry NSF Call
- New global challenges, into which chemistry, due to its pervasive nature, is able to play a very important role; eg. Energy, Nanoscience and Healthcare
- Greater interactions with other chemical companies, whose state of flux in the last few years has weakened some of the support leveraged via EPSRC.
- Highlighted Chemistry Grand Challenges in particular Utilising CO₂ in Synthesis and Transforming the Chemicals Industry; 'Dial-a-Molecule' – 100% Efficient Synthesis and Systems Chemistry: Exploring the Chemical Roots of Biological Organisation.

Threats

- Work with pharma may have a tendency to be too problem driven
- Conservatism within some elements of the community may not encourage future generations to take on the subject.



Our perception of the current position of UK synthetic chemistry research



Summary

The UK looks to be continuing to compete internationally with a number of world leading groups based in the UK. There are also good signs that this sub programme could maintain its strong position. Academics working in this area have secured a high proportion of the various fellowships. There are also opportunities for students in synthetic chemistry projects to gain training in highly innovative and exciting environments within CDTs.

Whilst there are good signs that there will be adventurous leadership in the future, there is also evidence that some very exciting projects are being undertaken at the moment. An area which particularly stands out for its creativity and for crossing borders is the work going on in organic synthesis at the boundary with the life sciences. Whilst there is also adventurous research going on within other parts of the discipline, a lot of the work is felt to be conservative in nature, as highlighted in the recent review of the Adventurous Chemistry call. There also appears to be very little interdisciplinary work going on in some parts of the portfolio.

Synthetic chemistry's strong areas are further reinforced by excellent links with pharma, where the feed in of knowledge from academics translates into an important contribution to the UK economy. There are also opportunities for chemists to tackle many problems associated with the current global challenges and if these are fully embraced then the contribution could be even greater.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC
Pioneering research
and skills

PHYSICAL SCIENCES PROGRAMME

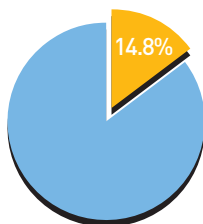
Physical chemistry

At a glance

Physical Chemistry covers the sub areas: Chemical structure; Colloids, soft solids and complex fluids; Combustion; Computational and theoretical chemistry; Electrochemistry and electrochemical engineering; Gas and solution phase reactions; Physical organic chemistry; and Solid-state chemistry.

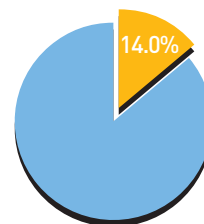
Grants funded

239
14.8% of Programme



Grants value

£103.4M
14.0% of Programme



Greatest cross sub-theme connectivity

Analytical Science
Catalysis
Synthetic Chemistry
Light-Matter Interaction



Greatest user collaboration

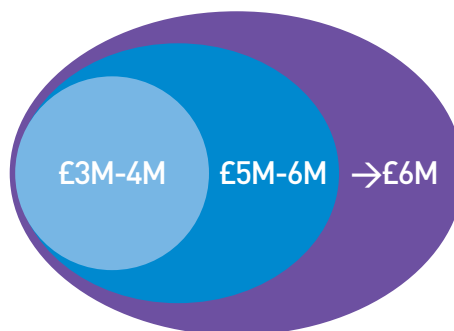
Johnson Mathey
AstraZeneca
Unilever
XstaBio Ltd
Scottish Enterprise

Leading centres based on EPSRC funding

- Cardiff Centre for Physical Organic Chemistry, Science and Innovation Award
- Bristol-Oxford Collaboration, Large Grant
- Strathclyde, Science and Innovation Award
- Oxford, A Multidisciplinary Research Centre for Advanced Electron Paramagnetic Resonance, Large Grant

Universities within sub theme by EPSRC funding

Oxford	Cambridge	Bristol
Strathclyde	Nottingham	Imperial
UCL	Liverpool	
Edinburgh	Durham	
Cardiff	Manchester	
Bath		
Leeds		
Southampton		
Warwick		



Physical chemistry Research capability

Centres for doctoral training

University	Name of centre
Leeds	Physical Methods and Life Sciences DTC*
Imperial	Chemical Biology DTC*

* Joint funded by C-DIP and crosses over with analytical chemistry

PhD and postdoc fellows

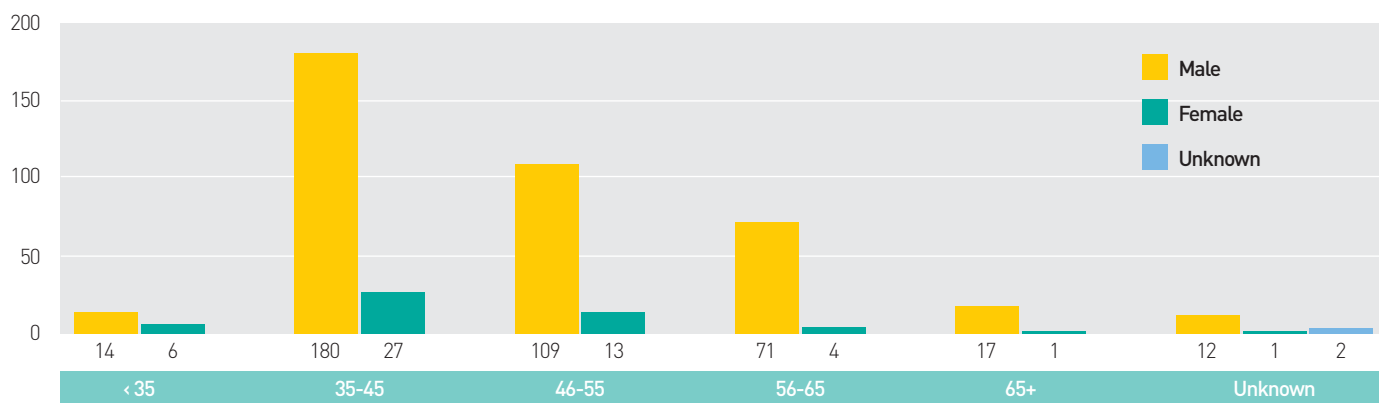
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
302 3.4% of EPSRC total	N/A



Fellowships

Advanced research fellows		Number: 7	Total: 3.3%
Prof JN Harvey – Bristol	Dr N Fey – Bristol	Dr JRR Verlet – Durham	Dr VM Betz – Warwick,
Prof L Cronin – Glasgow	Dr SR Mackenzie – Oxford	Dr P Licence – Nottingham	Dr KB Holt – UCL
DR JP Reid – Bristol	Dr S Magennis – Manchester		
Senior research fellows		Number: 2	Total: 8.7%
Prof PR Raithby – Bath,	Prof CA Hunter – Sheffield		
Leadership fellows		Number: 2	Total: 8.7%
Dr JP Reid – Bristol	Dr AJ Mulholland – Bristol		

Demographics



Based on principal and co-investigators

Physical chemistry

Swot analysis

Strengths

- There is high demand for funding in the physical chemistry portfolio with an above average success rate. Physical chemistry also has a lot of first grants, and a number of fellowships, particularly advanced fellows, indicating that this area is very healthy and has a secure future. This is backed up by the fact that this is a fairly young community with a lot of academics under 45. There are a number of large grants
- Physical chemistry continues to be strong in the area of small molecules both in theory and experiment. There is also good overseas collaboration in theoretical and computational chemistry
- Facilities are a key strength e.g. neutron and x-ray scattering – National Crystallographic Centre, Southampton. Diamond, ISIS and RAL – Harwell.

Opportunities

- Further interaction between theoretical, modelling and experimental communities could lead to more productive collaborations
- Influential developments have occurred in methodology in computational chemistry, but needs to be nurtured further
- Further diversification into large molecule research
- Grand Challenges present opportunities across Physical Chemistry
- NSF Call
- Mission Programmes, particularly Nanotechnology and Energy who have calls in the area of Physical Chemistry.

Weaknesses

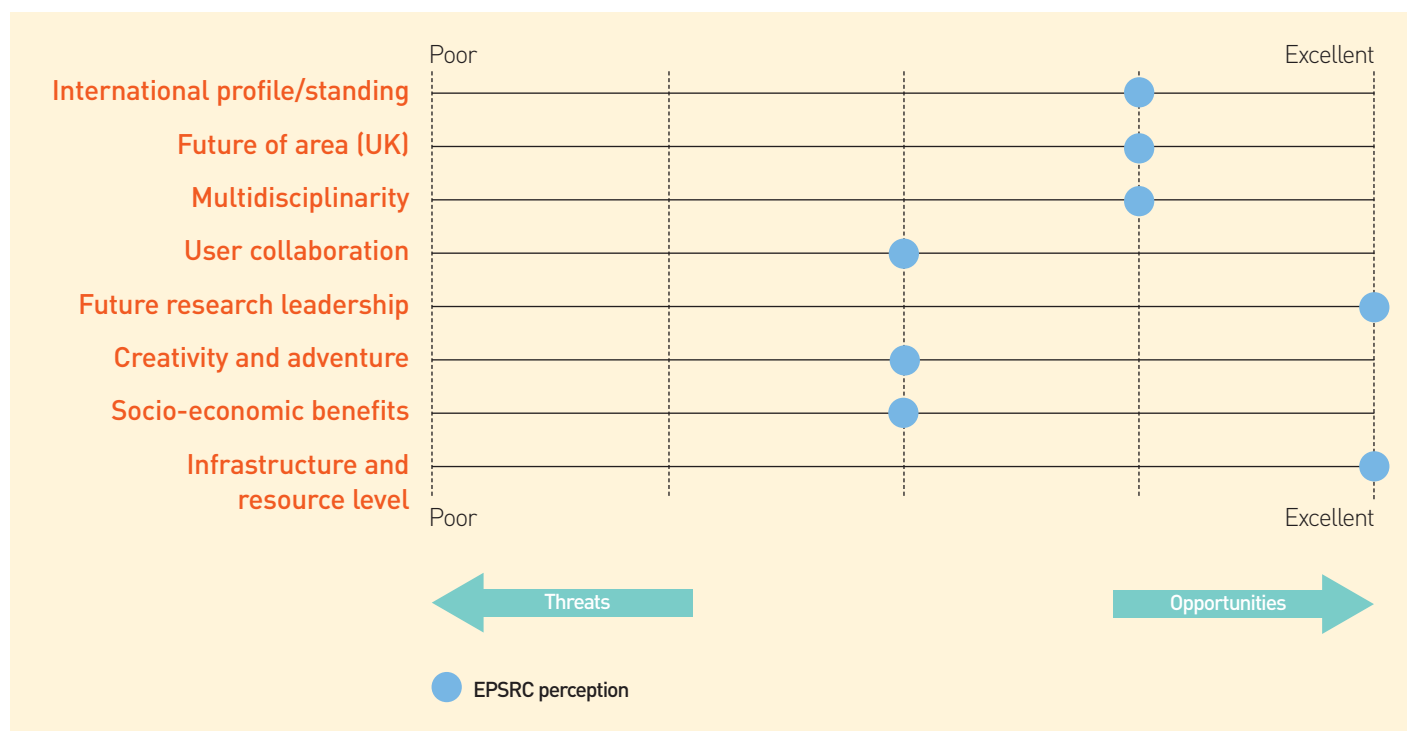
- The sub-area Physical Organic Chemistry has needed to be strengthened in the past. In recent years there have been two calls for proposals in this area and Science and Innovation Awards to support this topic
- Potential for overcrowding in this area especially small molecule research – high volume of people bidding for money in a few years time. This may be an area for diversification
- There are a low number of female researchers across all age groups.

Threats

- As with all areas of research the current economic downturn could affect the physical chemistry sub-programme
- If physical chemistry does not diversify then opportunities may be lost in related fields.



Our perception of the current position of UK physical chemistry research



Summary

Physical chemistry is a strong area in the UK and looks to continue this trend with a large number of first grants, high demand and above average success rates for proposals. The future of the area appears to be secure with a number of advanced fellowships and a high number of students going into physical chemistry.

More interaction is now occurring between the theoretical and experimental communities in all areas of physical chemistry. The UK has retained its international standing in niche areas such as theoretical and experimental study of small molecules. Other areas like atmospheric and gas phase chemistry is flourishing in a small number of institutes.

The data shows that user collaboration is low; this is an area which could be addressed.

Perhaps physical chemistry needs to widen its horizons and look for collaborations with other disciplines.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC
Pioneering research
and skills

PHYSICAL SCIENCES PROGRAMME

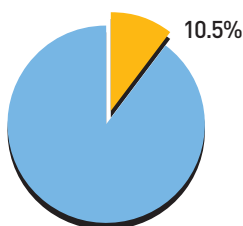
Condensed matter physics

At a glance

This theme includes the physics of superconductors, magnetic materials and semiconductors and magnetic phenomena. This area also includes research into systems of correlated electrons, physics of spintronics and quantum fluids and solids. More generally this theme covers experimental electronic, structural, computation and theoretical condensed matter physics. Also included is soft condensed matter physics, which includes colloids, soft solids, complex fluids and biological physics.

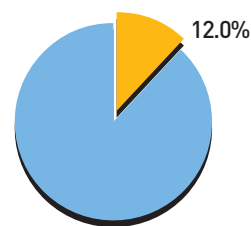
Grants funded

170.5
10.5% of Programme



Grants value

£93M
12.0% of Programme



Greatest cross sub-theme connectivity

Superconducting, magnetic and photonic materials

Atomic Molecular and Optical Physics

Physical Chemistry



Greatest user collaboration

Accelrys Limited

Hitachi Europe Ltd

DSTL

Bruker

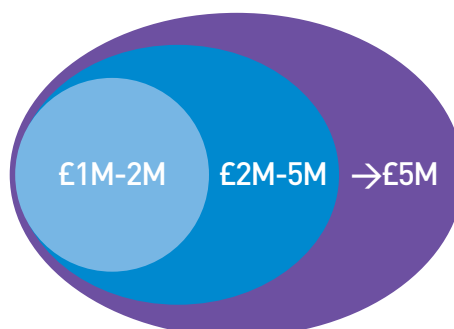
Good user collaboration with STFC facilities and Diamond, but as co-applicants, rather than through direct or indirect financial contribution to the projects

Leading centres based on EPSRC funding

- Cambridge – Theory of Condensed Matter, Semiconductor Physics, Thin Film Magnetism
- Oxford – Condensed Matter
- Lancaster – Low-Temperature Physics
- Edinburgh – Life Physics @ Ed
- UCL, Imperial – London Centre for Nanotechnology

Universities within sub theme by EPSRC funding

Imperial	Bristol	Cambridge
Liverpool	Lancaster	St Andrews
Durham	Leeds	Nottingham
Bath	Birmingham	Sheffield
RHUL	UCL	Edinburgh
Exeter	Warwick	Oxford



Condensed matter physics Research capability

Centres for doctoral training

University	Name of centre
University of St Andrews	Condensed Matter Physics DTC

PhD and postdoc fellows

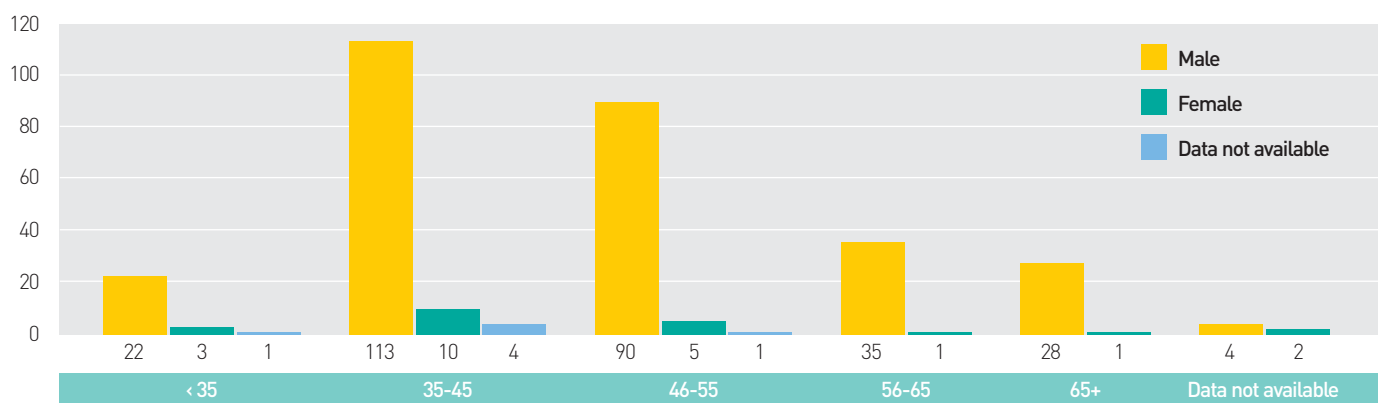
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
160.9 1.8% of EPSRC total	4



Fellowships

Advanced research fellows		Number: 15	Total: 7.1%
A Armour – Nottingham	D Atkinson – Durham	DM Gangardt – Birmingham	CA Hooley – St Andrews
DN Krizhanovskii – Sheffield	I Loa, Edinburgh	C Lobo – Cambridge	S Lynch – UCL
S Saveliev – Loughborough	N Shannon – Bristol	HR Sharma – Liverpool	A Tartakovskii – Sheffield
V Tsepelin – Lancaster	SM Fielding – Manchester	A Patane – Nottingham	
Career acceleration fellows		Number: 5	Total: 21.7%
WR Branford – Imperial	JMJ Keeling – Cambridge	T Lancaster – Oxford	M Nam – Oxford
R Oulton – Bristol			
Leadership fellows		Number: 1	Total: 4.3%
CJ Pickard – St Andrews			

Demographics



Based on principal and co-investigators

Strengths

- The international profile of this topic is generally high, with world leaders currently in the UK
- This topic has some very strong aspects, and has an interesting future ahead of it in up and coming areas such as spintronics, although further work is needed for this area to be internationally leading
- There is a high focus on attracting, nurturing and supporting talented researchers throughout their career, with appropriate numbers of first grants and fellows in this area
- The centre for doctoral training in condensed matter physics will provide additional support of the future supply of people in this area
- Although the size of the soft condensed matter and biological physics community is small, the UK is home to some world leading groups
- This topic is strengthened by the presence in the UK of world-class facilities and the community contains active users of international facilities world-wide.

Weaknesses

- Although this topic has a high number of researchers in the 35-45yr bracket, the number under 35 is less than might be expected; there may be a need for more active succession planning. Identifying future leaders in the UK will be important over the next decade
- Some areas in condensed matter physics suffer from having a small competitive reviewer pool
- The UK community in soft condensed matter and biophysics is very small relative to communities in other countries.

Opportunities

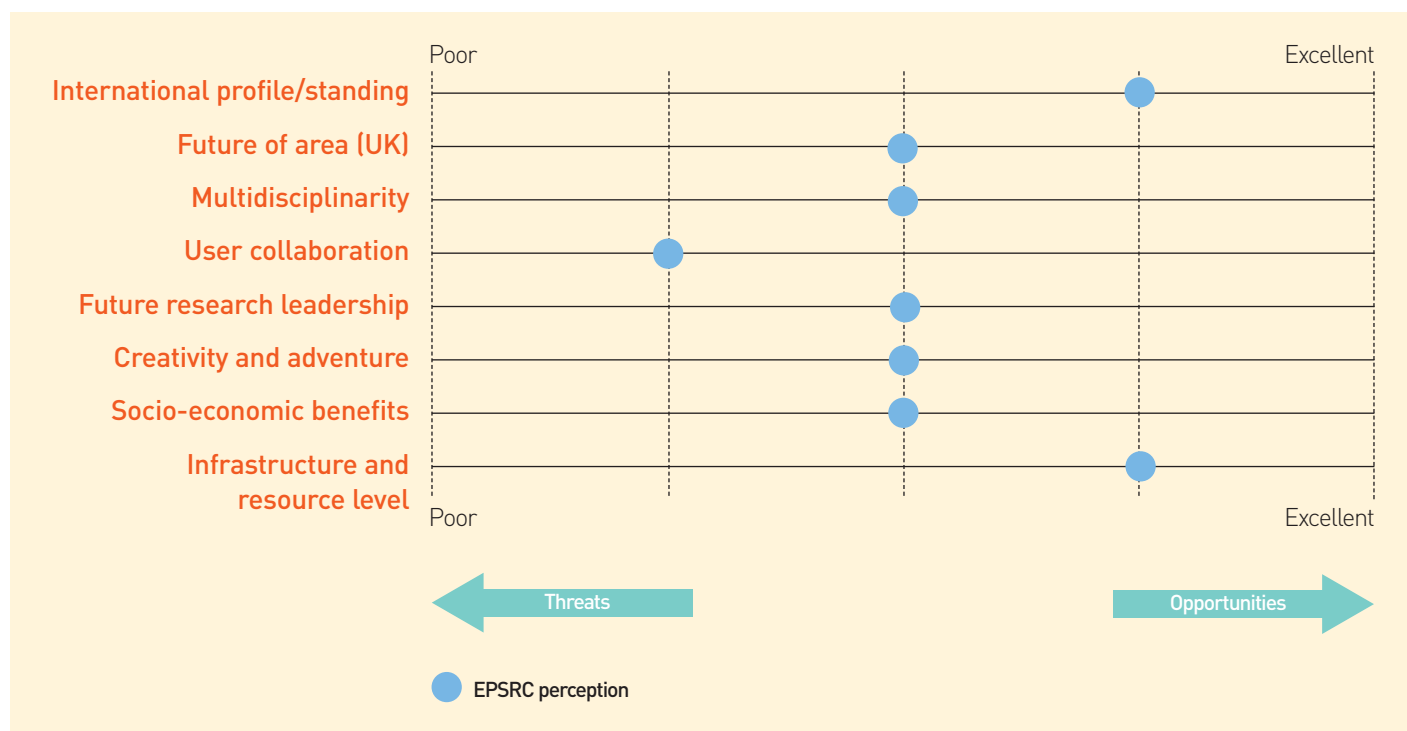
- The distinct areas of research within this portfolio link well with each other, and in many cases well with those outside of physics disciplines. This could always be further developed
- Whilst the level of interaction with industry is high (in the form of companies providing letters of support on grants) the level of industry input into projects is relatively low (in the form of project partners). This could be something which could be developed for example in research relating to data storage or soft condensed matter
- Fellowships are in high demand here, but some communities are not putting as many applicants through as others
- Opportunities for funding in the Physics-Life Sciences Interface signpost.

Threats

- Funding is relatively steady across the theme, but areas such as Strongly Correlated Systems and Theory and Computational condensed matter physics have lower success. The post-doctoral fellowships in theoretical physics go some way to help this
- There are a number of small communities in this theme (Quantum Fluids, Soft Condensed Matter etc), and there is a danger that in these areas there will be a gap in undergraduate teaching of these subjects, and as such the interest in this area could decline.



Our perception of the current position of UK condensed matter physics research



Summary

The condensed matter physics community is a relatively large one, with many strands to it with variations from strand to strand. The high number of fellows across the remit shows the potential for leadership in the future, although it is of note that soft condensed matter has fewer fellows than might be expected. Recent support in the area of spintronics reflects the perceived importance of this area, and the key players in the UK seem keen to drive this area forward particularly in an international context. The quantum fluids community seem to be a close community, but relatively isolated. This appears to be contrasted in other areas of the portfolio which reach wider afield.

There was appropriate interest in the centres for doctoral training call from within this area, resulting in a centre being funded in St. Andrews. This, combined with a relatively high success rate for the programme suggests that core condensed matter physics is well resourced, and sustainable. This area also makes good use of medium and large scale facilities, both in the UK and internationally.

One perception is that there is less adventure in proposed research than in others, and there is a danger that while other themes look for large step changes, this theme has a greater level of incremental research. This is not an issue by itself, as long as there is a drive by some to look for new larger challenges. Creativity is high in such areas as biophysics and quantum coherence. A greater involvement of industry in supporting proposals would be welcomed, along with an increase of project partners on proposals in this area.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC
Pioneering research
and skills

PHYSICAL SCIENCES PROGRAMME

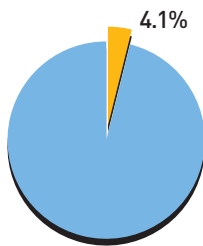
Plasmas, lasers and optics

At a glance

Plasma physics covers technological, laser and fusion plasmas. This does not cover support for the UK Fusion Programme whose budget comes through EPSRC from the Energy Programme. This theme also covers research into lasers and laser systems, optical devices and phenomena, applied optics and optoelectronic devices.

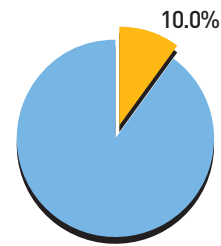
Grants funded

66.5
4.1% of Programme



Grants value

£30.7M
10.0% of Programme



Greatest cross sub-theme connectivity

- Atomic, Molecular and Optical Physics
- Photonic Materials and Devices
- Condensed Matter Physics



Greatest user collaboration

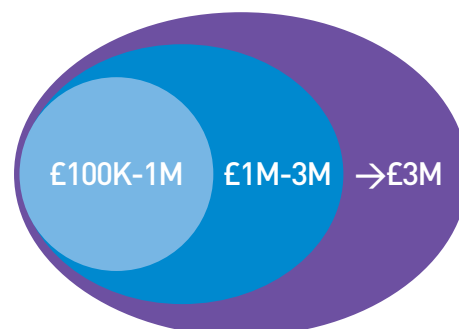
- EURATOM/UKAEA Fusion Association
- General Atomics
- TMD Technologies Ltd
- Andor Technology Ltd
- DSTL

Leading centres based on EPSRC funding

- Warwick, Centre for Fusion, Space and Astrophysics (Science and Innovation Award)
- Queen's University Belfast, Centre for Plasma Physics (Science and Innovation Award)
- Imperial, Plasma Physics and Quantum Optics and Laser Science Groups
- Strathclyde, Plasmas Division

Universities within sub theme by EPSRC funding

Oxford	Liverpool	Imperial
Bristol	Loughborough	Strathclyde
Cambridge	QMUL	Heriot-Watt
Southampton	St Andrews	Warwick
UCL	Sheffield	QUB
York		



Plasmas, lasers and optics

Research capability

PhD and postdoc fellows

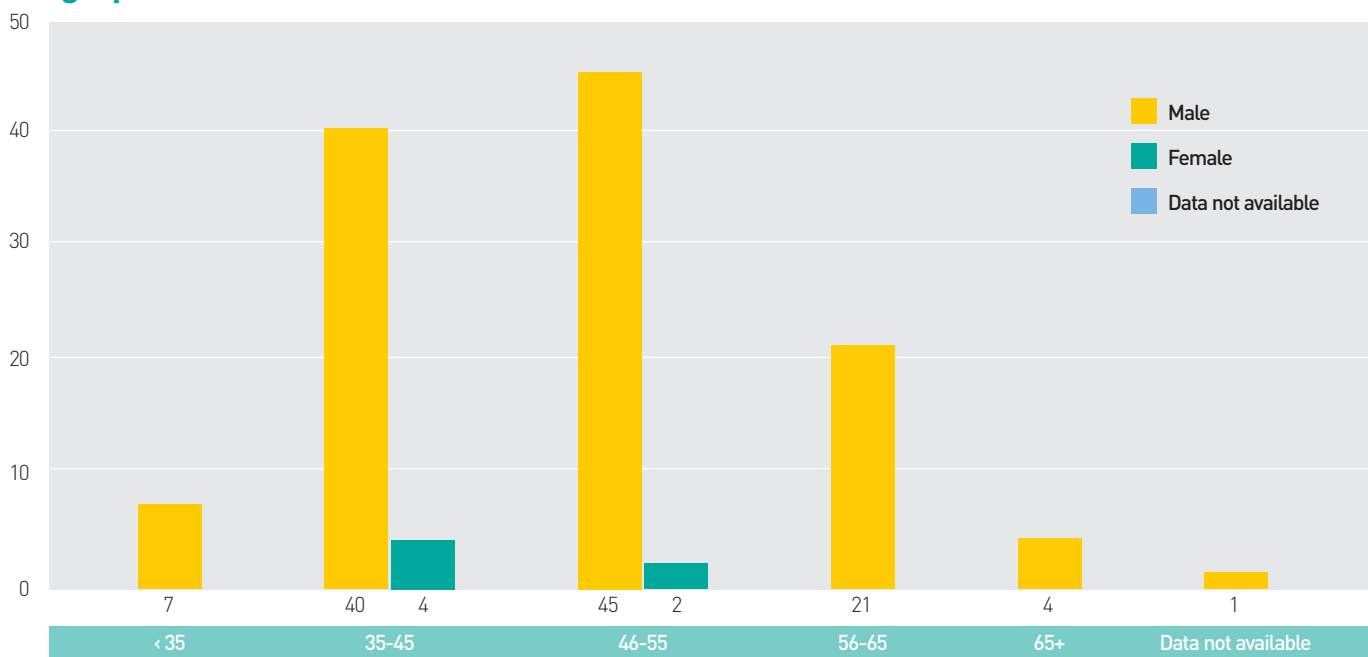
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
133 1.5% of EPSRC total	0



Fellowships

Advanced research fellows	Number: 4	Total: 3.1%	
Dr SN Bland – Imperial	Dr R Peverall –Oxford	Dr CF Faria – UCL	Dr ID Lindsay

Demographics



Based on principal and co-investigators

Swot analysis

Strengths

- The UK has some world-leading groups across the breadth of plasma physics, laser research and optics
- The communities represented in this theme have access to world-class facilities based in the UK
- The two Science and Innovation awards, awarded in 2006, will boost plasma research in the UK, providing for the future of this important area – the appointees so far have been very strong
- There are a number of large responsive mode grants held across a range of groups in laser and optics research.

Weaknesses

- There is some fragmentation in the plasma physics community and a perception at responsive mode panels that research in this area is not as adventurous as other areas of the physical sciences portfolio
- Although there are currently a number of large grant holders in this theme, interest in EPSRC longer, larger grants schemes such as Platform and Programme Grants has been low thus far

Opportunities

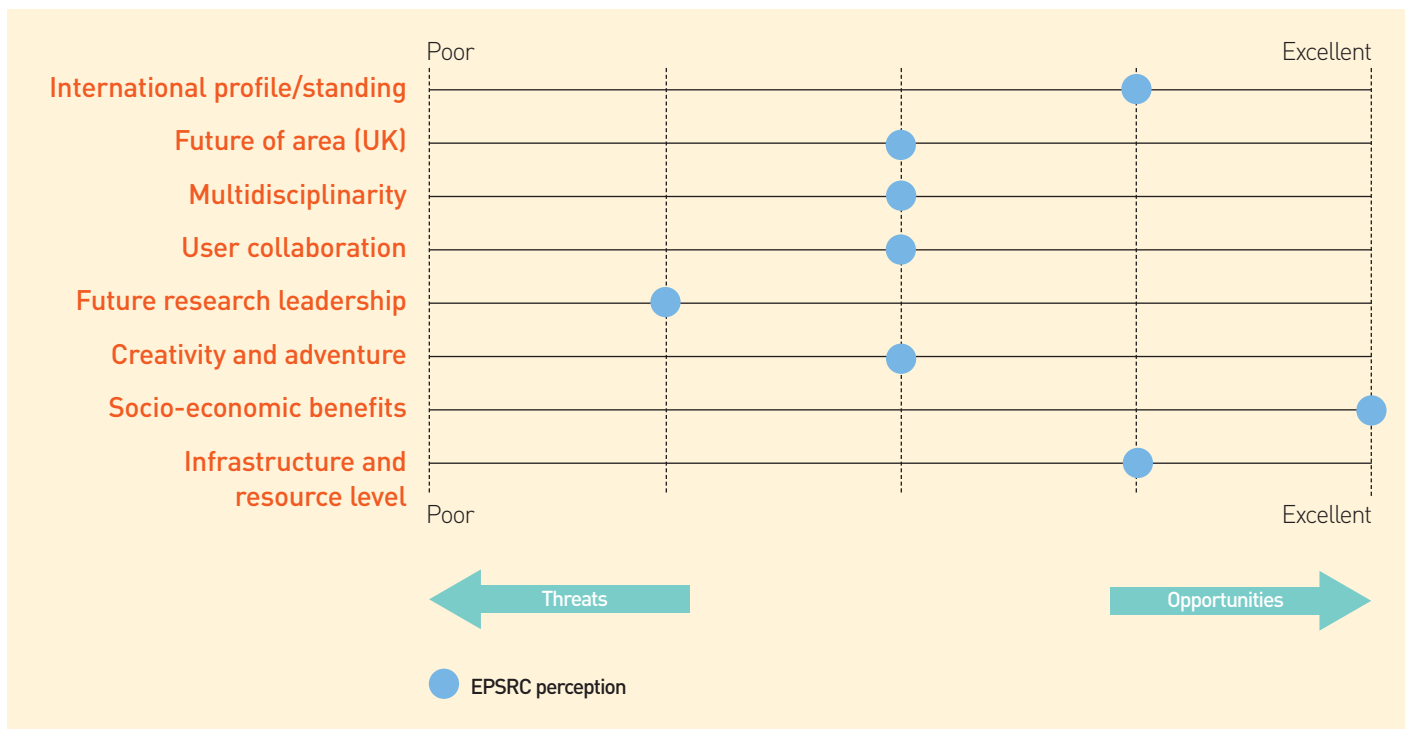
- The technological plasmas community demonstrates good links with industry (through letters of support, acting as project partners), though this area could be developed further
- The potential for cross-disciplinary activity is high in this theme (e.g. interface with the life sciences, space science, engineering, defence). Some work is going on in this area but there is scope for more.

Threats

- The demand for EPSRC fellowships from the communities in this theme is not as high as would be expected. Thus, although the Science and Innovation Award will provide funding for new posts in plasma physics in the medium term there are large activities currently funded in the lasers and optics communities, there is a danger that in the long term future leaders will not emerge.



Our perception of the current position of UK plasmas, lasers and optics research



Summary

The communities represented in this theme have some highly visible research leaders. The communities are currently well resourced, with two Science and Innovation awards and other various large activities across the breadth of the theme. However, the demand for early career fellowships (EPSRC PDRFs and CAFs) in this area is low and this may lead to a lack of leadership in the long-term. Funding for this area can also come from other agencies (e.g. STFC, NERC, AWE). There is great potential for both inter- and multidisciplinary working and increasing user collaboration. Although plasma physics as a whole has a good international profile, at responsive mode panels it is sometimes considered less adventurous and/or creative when compared to other areas of the physical sciences portfolio. In terms of socio-economic benefits, if fusion ‘works’ then it will provide cheap, environmentally friendly power for the world, which is obviously a huge benefit. On a smaller scale but shorter timescale, technological plasmas are vital for materials processing and other applications and have obvious economic impact.

All the communities represented within this theme should develop strategies for maintaining research leadership in the areas where the UK is currently very strong.

Engineering and Physical Sciences Research Council

Polaris House
 North Star Avenue
 Swindon
 SN2 1ET
www.epsrc.ac.uk



PHYSICAL SCIENCES PROGRAMME

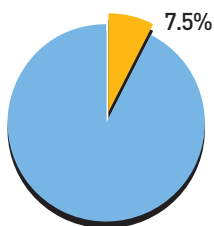
Atomic, molecular and optical physics

At a glance

This theme covers research in cold atomic species, light-matter interactions, quantum optics, quantum information processing (QIP) and scattering and spectroscopy.

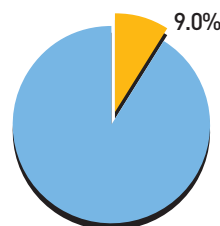
Grants funded

121
7.5% of Programme



Grants value

£71.1M
9.0% of Programme



Greatest cross sub-theme connectivity

- Computer Science
- Mathematical Physics
- Physical Chemistry



Greatest user collaboration

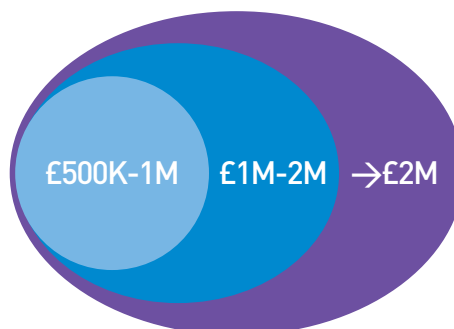
- DSTL
- Hitachi

Leading centres based on EPSRC funding

- Quantum Coherence: Joint Proposal for Optimising UK Research Capacity and Capability, Science and Innovation Award, Oxford, Imperial and Cambridge
- The Midlands Ultracold Atom Research Centre, Science and Innovation Award, Nottingham, Birmingham and Warwick
- QIP IRC, involving 9 universities centred at Oxford (experimental & theory) and Bristol (underpinning theory)
- Swansea & UCL, Positronium work

Universities within sub theme by EPSRC funding

Swansea	Liverpool	Oxford
Royal Holloway	UCL	Cambridge
Durham	Bristol	QUB
Sheffield		Nottingham
Southampton		Imperial



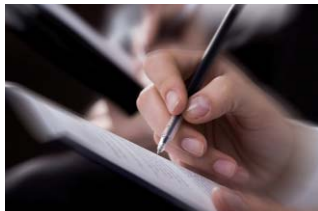
Research capability

Centres for doctoral training

University	Name of centre
Imperial	Controlled Quantum Dynamics

PhD and postdoc fellows

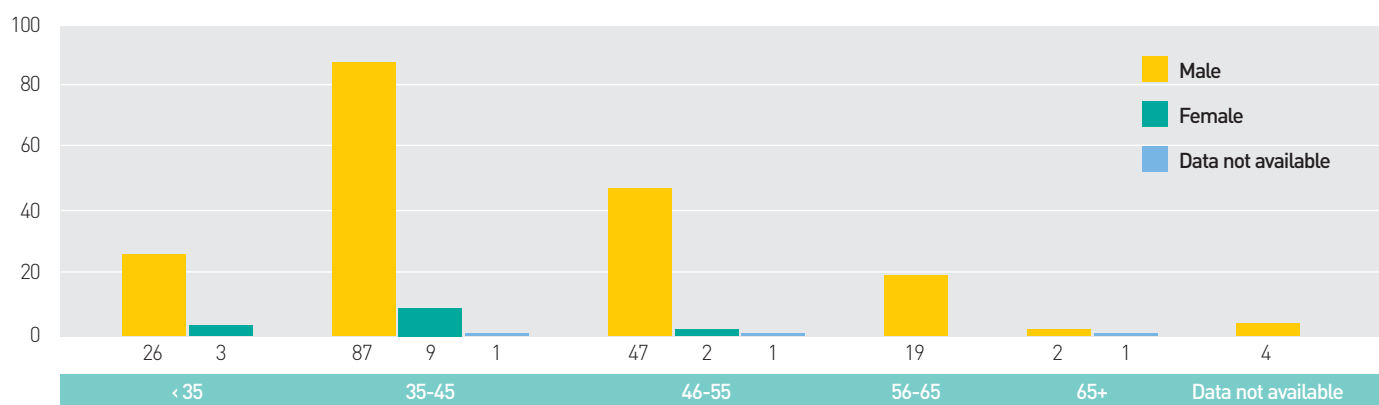
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
205 2% of EPSRC total	9



Fellowships

Advanced research fellows				Number: 12	Total: 5.7%
Prof BTH Varcoe – Leeds	Dr S Scheel – Imperial	Dr JA Dunningham – Leeds	Dr TG Rudolph – Imperial		
Dr FM Marchetti – Oxford	Prof S Bose – UCL	Dr S Schirmer – Cambridge	Dr MPA Jones – Durham		
Dr AF Ho – Royal Holloway	Dr S Jonsell – Swansea	Prof PF Barker – UCL			
Senior research fellows				Number: 1	Total: 4.3%
Prof M Charlton – Swansea					
Career acceleration fellows				Number: 4	Total: 17.4%
Dr A Olaya-Castro – UCL	Dr I Fuentes-Schuller – Hertfordshire	Dr M Paternostro – QUB	Dr J Barrett – Bristol		
Leadership fellows				Number: 1	Total: 4.3%
Dr WK Hensinger – Sussex					

Demographics



Based on principal and co-investigators

Swot analysis

Strengths

- Some areas have a high international profile, QIP theory is internationally leading. Work in cold atoms and experimental QIP had been lagging it is now catching up
- There are good networks within the UK and international collaborations
- Young people are enthused by some of the subjects covered within this topic and there is a strong ethos of supporting and developing the careers of talented researchers. There is a strong demand for early career support in the areas of cold atoms and QIP, particularly theory. The CDI at imperial should sustain interest.

Weaknesses

- The community does not put a great deal of emphasis on demonstrating the potential for economic impact of their research
- There are very few collaborations with users
- In some areas such as scattering and collisions demand for fellowships is low; this may mean new talent is not coming through and the area may be in decline. However, this may be a natural progression.

Opportunities

- Opportunities for greater international collaboration, pairing best with best particularly within Europe
- There are opportunities for greater collaboration within the field, particularly in quantum information. This includes cross programme activities and user collaboration
- Many goals have been reached in the cold atom field, there may now be an opportunity to move towards the development of technology
- The recently funded network in cold atoms and condensed matter is an opportunity to build on the success of the quantum coherence signpost.

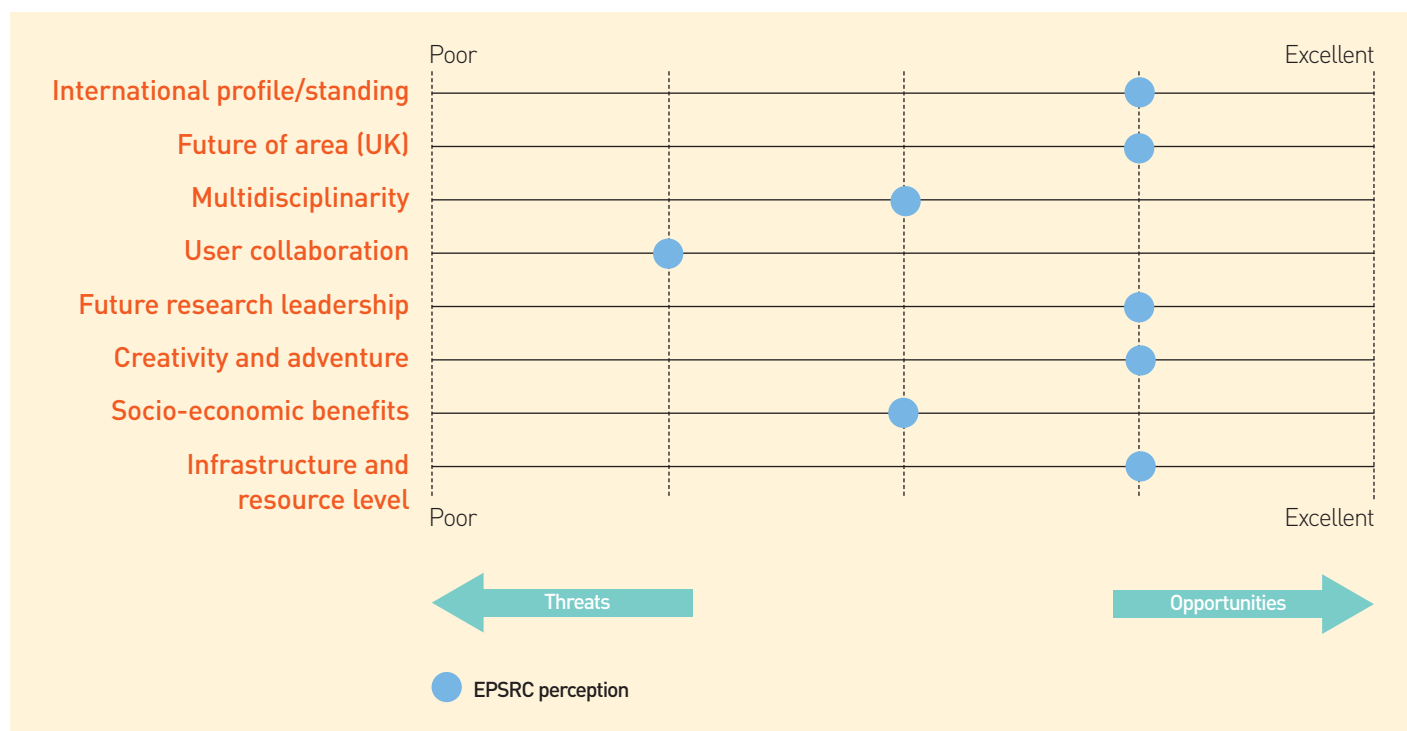
Threats

- Some areas such as quantum information and cold atoms are seen as 'hot topics' and are very popular. Other areas of atomic, molecular and optical physics could suffer from this success
- The QIP IRC has been a unifying force in the community. The IRC grant will end in 2009 and progress in this field should be monitored closely.



Perceptions

Our perception of the current position of UK Atomic, molecular and optical physics research



Summary

Some areas covered by this sub theme are internationally leading or rising in status, however other areas are in decline. Whether this is a threat to the field or a natural progression is yet to be seen. The past 10 years has seen significant advances in the field of cold atoms; future priorities should build on our already strong position. There are good networks and collaborations within the UK. Collaborations mainly focus on intra-disciplinary collaboration – e.g. crossover between AMO physics with condensed matter in the area of quantum coherence. QIP is highly interdisciplinary, involving many of the areas covered by the physical sciences programme. The UK has a leading position in some areas; it would be advantageous to consolidate this and develop more international collaborations partnering best with best particularly within Europe. There is an opportunity for greater user engagement and collaboration particularly in the field of quantum information processing. Greater understanding of economic and social impact of technologies and particularly in respect of emerging technologies would benefit the community and their interaction with users.

Engineering and Physical Sciences Research Council

Polaris House
 North Star Avenue
 Swindon
 SN2 1ET
www.epsrc.ac.uk



PHYSICAL SCIENCES PROGRAMME

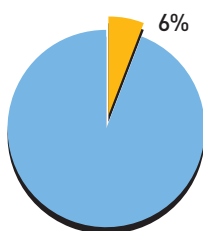
Catalysis

At a glance

Catalysis involves research in the areas of catalysis and applied catalysis; and surfaces, surface probes and interfaces. Work in this area includes structural and kinetic studies to understand molecular mechanisms involved in catalytic reactions, preparing novel or improved catalysts, manufacture of catalyst and reactor systems.

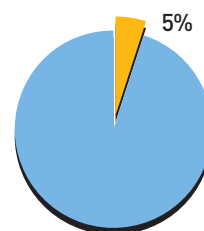
Grants funded

98
6% of Programme



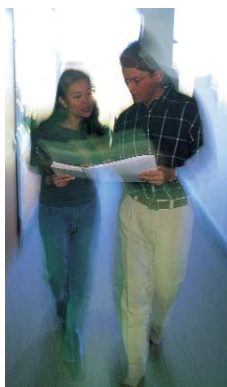
Grants value

£40M
5% of Programme



Greatest cross sub-theme connectivity

- Synthetic Chemistry
- Physical Chemistry
- Process, Environment and Sustainability
- Surface Science



Greatest user collaboration

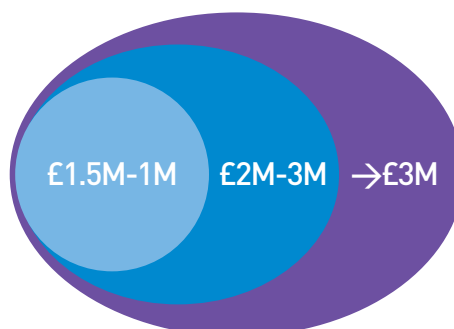
- Optopreneurs
- Johnson Matthey
- Microsharp
- AWE plc

Leading centres based on EPSRC funding

- Bath, Industrial Doctorate Centre
- Cambridge, Surface Science Group, Large grant
- UCL, Industrial Doctorate Centre
- Cardiff, School of Chemistry, 11 grants

Universities within sub theme by EPSRC funding

QUB	Cambridge	UCL
York	Cranfield	
St Andrews	Bath	
Nottingham	Imperial	
Oxford	Bristol	
Warwick	Liverpool	
	Cardiff	



Centres for doctoral training

University	Name of centre
Bath	Sustainable Chemical Technologies IDTC
Surrey	Micro- and NanoMaterials and Technologies IDTC
UCL	Molecular Modelling & Materials Science IDTC

PhD and postdoc fellows

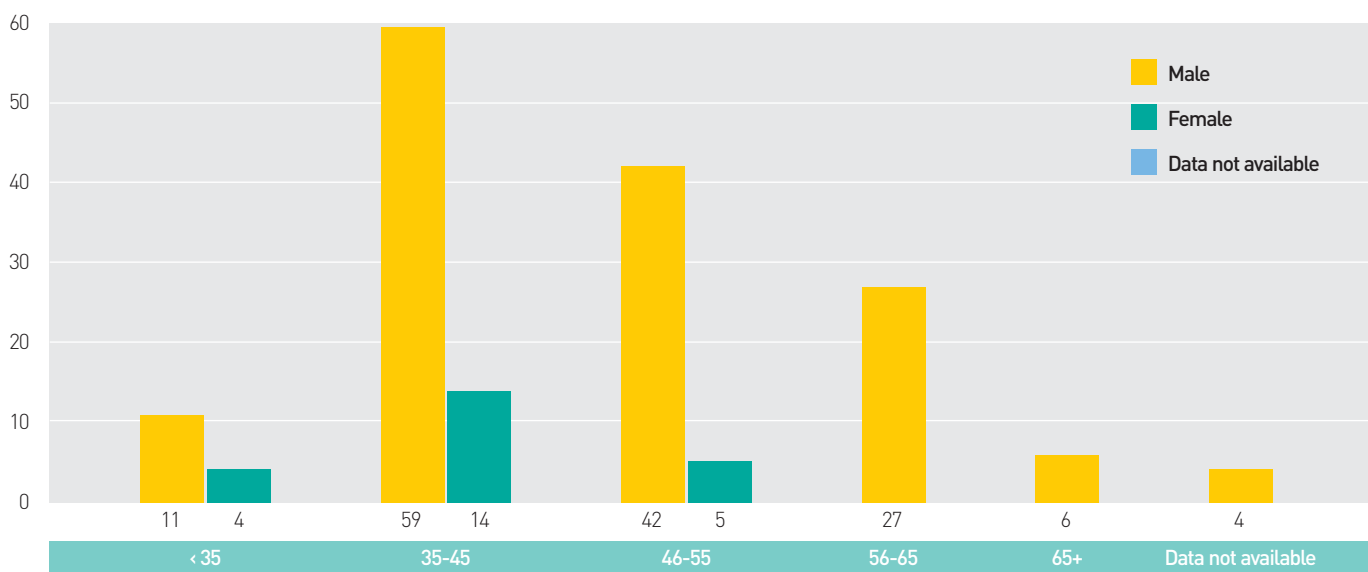
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
302 3.4% of EPSRC total	N/A



Fellowships

Advanced research fellows	Number: 3	Total: 1.4%
Prof RB Bedford – Bristol	Dr H Arnolds – Liverpool	Dr TD Sheppard – UCL
Leadership fellows	Number: 1	Total: 4.3%
Dr AF Lee – York		

Demographics



Based on principal and co-investigators

Strengths

- Catalysis has a number of first grants and fellowships suggesting that the community has a strong future. Demand for funding is fairly high and success rates are on the increase
- Catalysis has major strengths in both green and heterogeneous catalysis within the UK and is internationally leading in supported metal NP catalysis and enantioselective reactions
- Developing strong links with materials and retaining strong links with physics.

Weaknesses

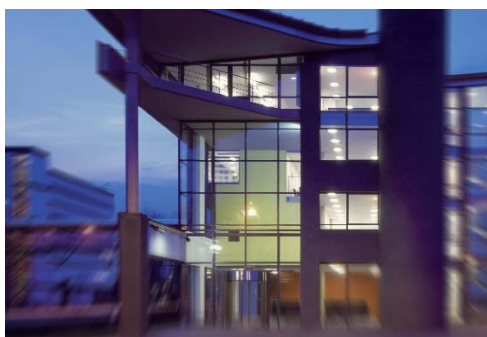
- The current success rates are below average, however these are on the increase
- The catalysis portfolio has only one platform grant is which low when compared to other portfolios within Physical Sciences.

Opportunities

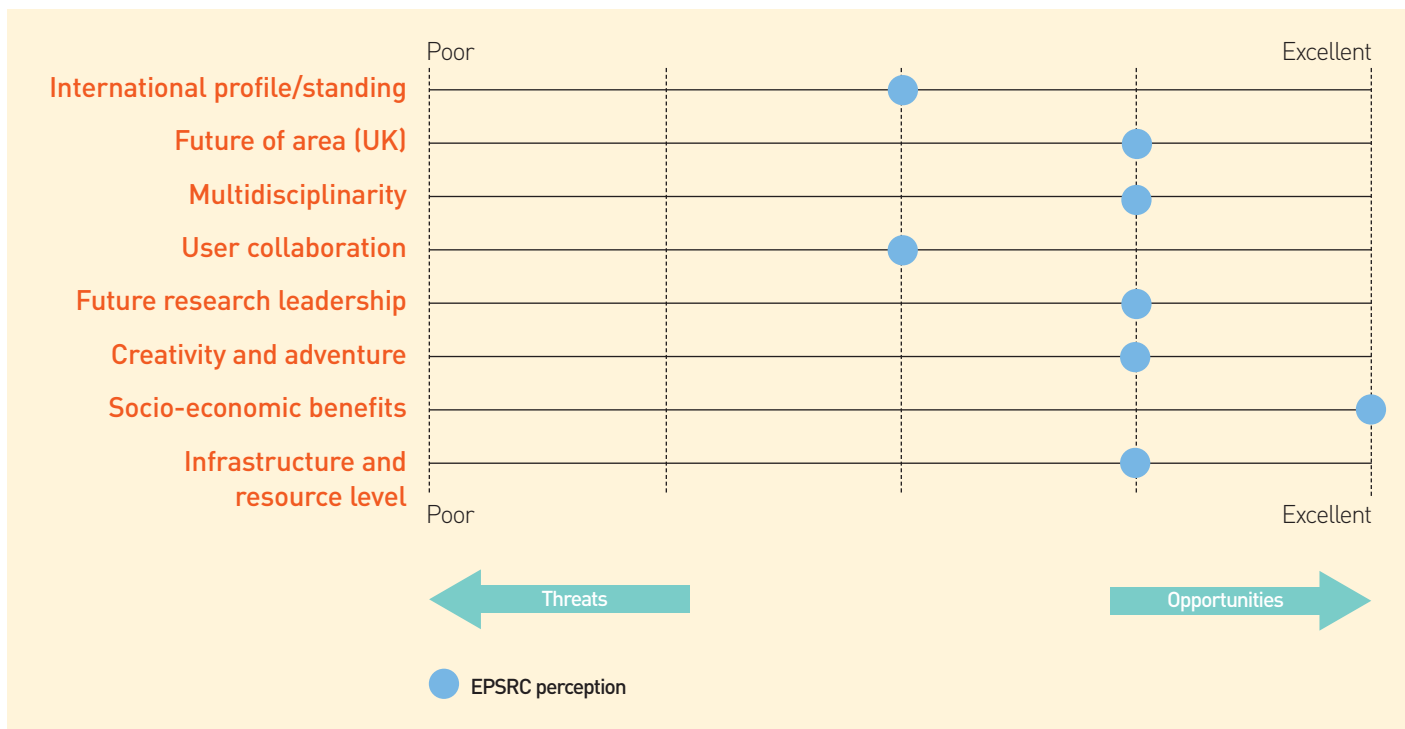
- Catalysis will have a major part in play in creating new or improving existing processes that are both environmentally and economically sustainable
- The recent RAE report indicated that catalysis is developing links with the Materials community and retaining strong links with Physics which could lead to fruitful collaborations if exploited correctly
- Catalysis is seen as an underpinning theme of the Chemical and Engineering Grand Challenges, particularly the CO2 Grand Challenge
- EPSRC is a 'sleeping partner' on the ACENET ERA-NET – a network which offers the opportunity to work at a transnational level
- Nanotechnology Mission Programme.

Threats

- User collaboration only occurs between a handful of companies working with a handful of universities.



Our perception of the current position of UK catalysis research



Summary

Catalysis in the UK has major strengths in both green and heterogeneous catalysis and is internationally leading in supported metal nanoparticle catalysts. This sub-programme's future looks to be strong as it will have a part to play in the challenge of creating novel methods for economic and environmental sustainability. The community should be able to deliver on this challenge as it is a fairly young community with several fellows and a number of PhD students.

Collaboration with industry is strong, but it is only with a few companies and a few universities. Interaction should be encouraged so that more universities and companies can benefit.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC

Engineering and Physical Sciences
Research Council

PHYSICAL SCIENCES PROGRAMME

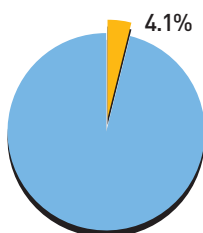
Analytical sciences

At a glance

The analytical sciences sub programme involves the development of novel measurement techniques, including sensors, chromatography, mass spectrometry and spectroscopy. Development of new methods of analysis by integration of state of the art principles of chemistry with instrumental, computational and chemometric methodologies that are all underpinned by rigorous theoretical understanding is also included. There is also some contribution from Instrumentation engineering and development.

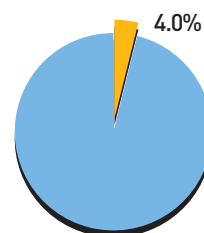
Grants funded

66
4.1% of Programme



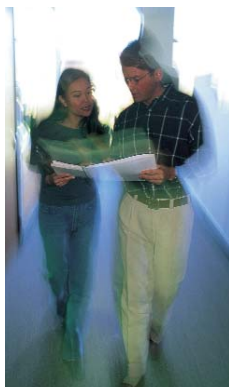
Grants value

£29.9M
4.0% of Programme



Greatest cross sub-theme connectivity

- Synthetic Chemistry and Biological related Chemistry
- Physical Chemistry
- M3E Sensors



Greatest user collaboration

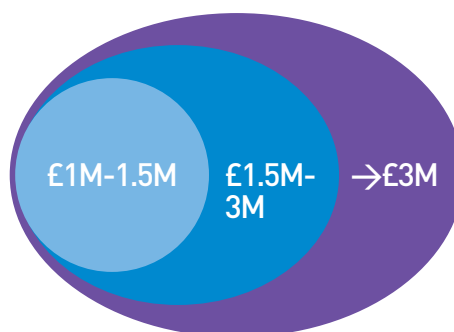
- Smiths Detection
- Bruker
- Rapiscan
- Ionoptika
- DSTL

Leading centres based on EPSRC funding

- Warwick Centre for Analytical Chemistry, Science and Innovation Award
- Cambridge, Multidiscipline Platform grant
- Manchester, New Developments in ToF-SIMS Surface Mass Spectrometry with ATR-IR Spectroscopy, Large grant
- Strathclyde, Multidiscipline Platform grant

Universities within sub theme by EPSRC funding

Light Blue	Dark Blue	Purple
Bristol	Imperial	Warwick
Cambridge	Manchester	
UCL	Birmingham	
Strathclyde	Glasgow	
Southampton	Sheffield	




Centres for doctoral training

University	Name of centre
Imperial	Chemical Biology DTC*
Warwick	Molecular organisation and assembly in cells DTC*
Birmingham	Biomedical Imaging DTC*
Glasgow	Proteomics Technologies DTC*

*Joint-funded with Cross-Disciplinary Interface Programme and crosses over with physical chemistry

PhD and postdoc fellows

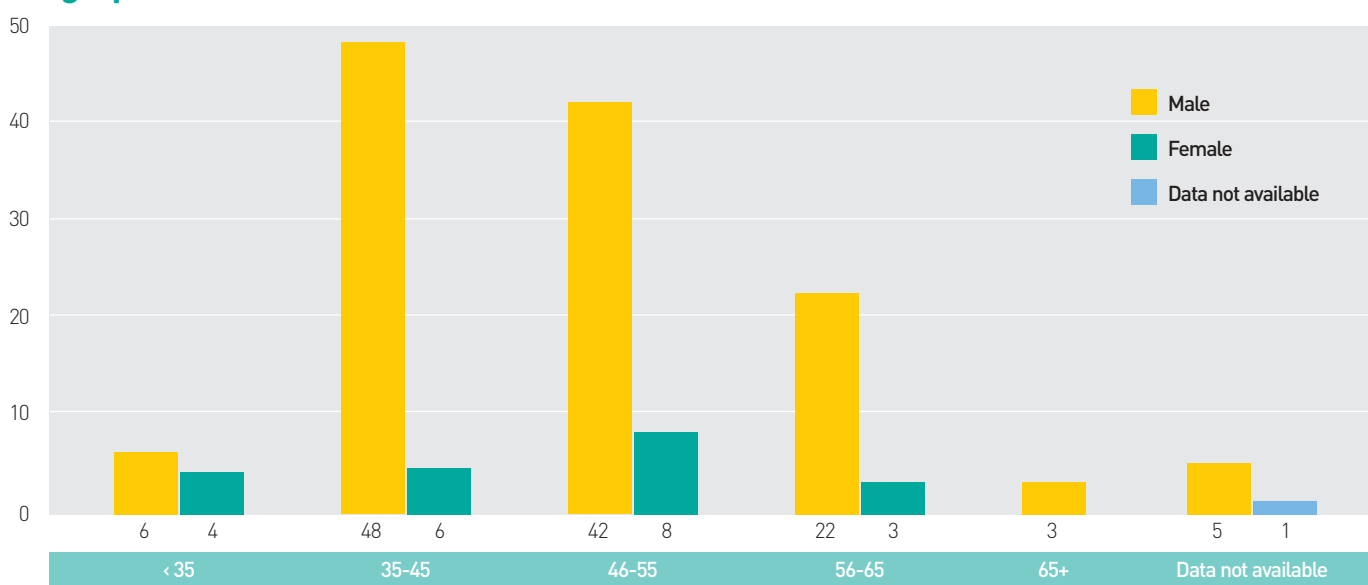
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
263 2.9% of EPSRC total	0



Fellowships

Advanced research fellows	Number: 2	Total: 0.6%
Dr M Tromp – Southampton	Dr LM Nilsson – Manchester	

Demographics



Based on principal and co-investigators

Analytical sciences

Swot analysis

Strengths

- Success rates for the analytical sciences are on the increase after recently being low
- There are 5 platform grants within the analytical sciences which suggests the area is fairly healthy at the current time
- The RAE report concluded that there have been notable advances in nano-systems, especially those which are biologically inspired.

Weaknesses

- There is both low demand and low success rate in analytical sciences, although success rates are now on the increase
- The number of first grants is below the EPSRC average, which could indicate leadership issues in the future
- User collaboration appears to be very low. I would expect collaboration with pharmaceutical companies such as GSK, Pfizer and Merck.

Opportunities

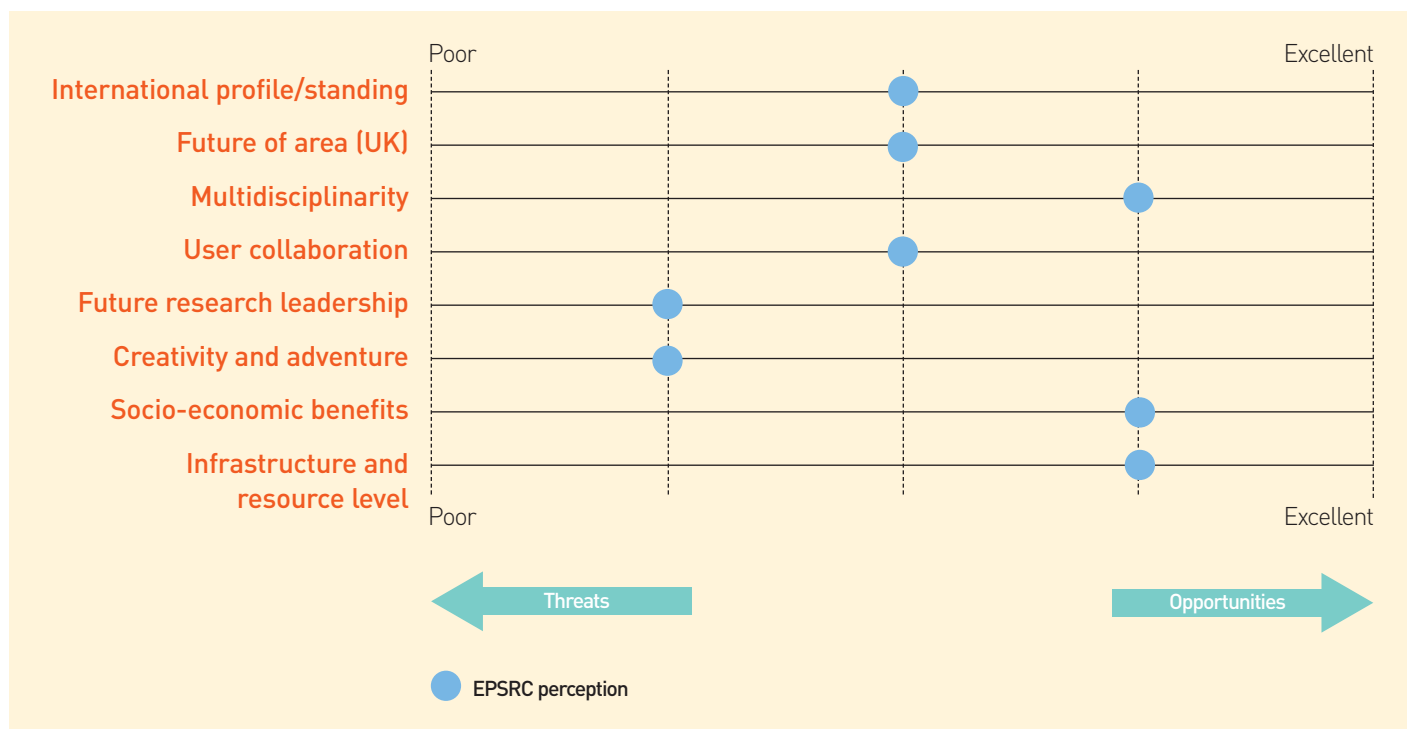
- The analytical sciences have many opportunities in interdisciplinary/multidisciplinary research, leading to a very broad-based programme of research. For example, there are interfaces between chemistry-biology, chemistry-medicine, chemistry-materials and chemistry-environment which could be exploited further
- EPSRC-funded analytical summer schools will allow more young researchers to develop core competencies and encourage students to carry on with analytical research
- A Science and Innovation award has been given to Warwick to support analytical sciences and to build capability within the UK
- Grand Challenges: Closing the Carbon Cycle, Dial-A-Molecule, Directed Assembly of Extended Structures with Targeted Properties and Chemical Roots of Biological Organization.

Threats

- There may be sustainability issues in the future as there are a very low number of fellowships in this area. There are quite a few PhD students but they do not seem to be staying in academia.



Our perception of the current position of UK analytical sciences research



Summary

Analytical sciences have a high number of PhD students; however the students do not stay in academia, more needs to be done to retain these students in order to sustain this community. However this does mean a large number of highly qualified people are going into industry and other career areas.

There is also a focus on end applications rather than the development of core analytical skills. Perhaps analytical PhDs should include a core component where students can develop these skills before focussing on an application so that a wider range of post doctoral positions are available to them after completion.

The data shows very little collaboration with industry, suggesting that this interaction needs to be strengthened.

A lot of research is applied rather than creative and ground-breaking.

Researchers tend to think of analytical science as a service and often do not consider themselves as analytical scientists. There is therefore a need to demonstrate the real benefits of analytical science as a subject area in order to attract future generations into the field.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC
Pioneering research
and skills

PHYSICAL SCIENCES PROGRAMME

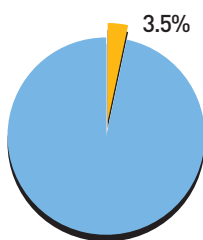
Functional materials

At a glance

This sub theme focuses on the research areas of synthesis, growth and characterisation of functional ceramics, inorganics, carbon nanotubes and graphene. Theoretical materials science of functional ceramics, inorganics, carbon nanotubes and graphene is also included. This review does not cover electronic materials for device application and photonic materials as these are covered within the ICT sub-themes listed below. Superconducting and magnetic materials are covered within a separate sub-theme within the Physical Science programme.

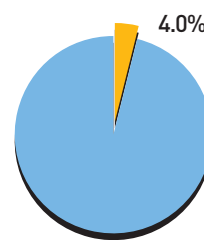
Grants funded

56
3.5% of Programme



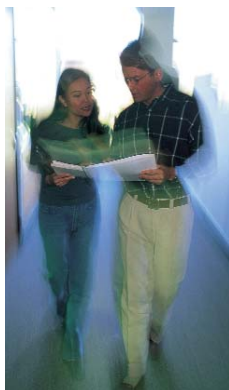
Grants value

£29.9M
4.0% of Programme



Greatest cross sub-theme connectivity

- Electronic materials and devices (ICT Programme)
- Photonic materials and devices (ICT Programme)
- Superconducting, magnetic and photonic materials (Physical Sciences Programme)



Greatest user collaboration

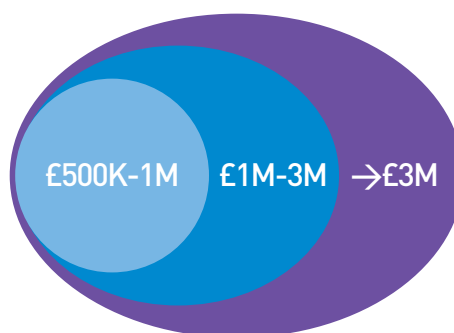
- GSI Lumonics Ltd
- DERA/DSTL/QinetiQ
- Plastic Logic Ltd
- National Physics Laboratory
- Rolls Royce

Leading centres based on EPSRC funding

- Manchester, Science and Innovation Award for Graphene Research, Mesoscopic Physics Group
- Sheffield, Ceramics and Composites Laboratory
- Exeter, Science and Innovation Award, Centre for Graphene Research
- Imperial and UCL, London Centre for Nanotechnology

Universities within sub theme by EPSRC funding

Light Blue	Dark Blue	Dark Purple
Heriot-Watt	Imperial	Manchester
Newcastle	Bath	UCL
QUB	Cambridge	Exeter
Bristol	Oxford	Sheffield
Edinburgh	Southampton	
Liverpool	Surrey	
Nottingham		
Warwick		



Functional materials Research capability

Centres for doctoral training

University	Name of centre
Imperial	Theory and simulation of materials DTC
UCL	Molecular modelling and materials science IDTC
Bristol	Functional nanomaterials DTC
Cambridge	Assembly of functional nanomaterials and nanodevices DTC
Manchester	Northwest Nanoscience DTC

PhD and postdoc fellows

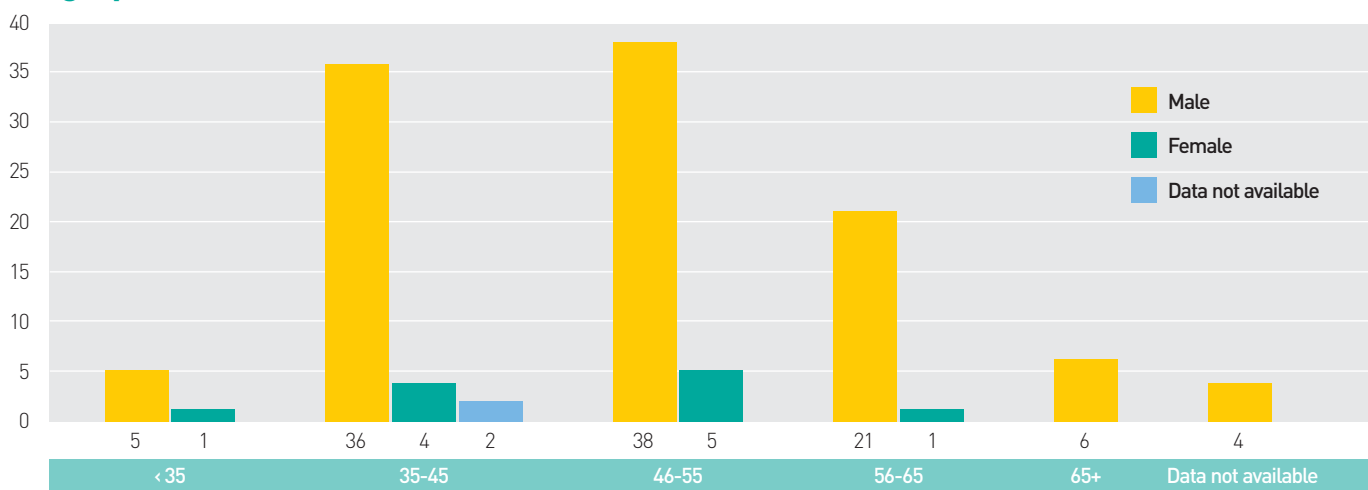
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
132 1.5% of EPSRC total	0



Fellowships

Advanced research fellows	Number: 1	Total: 0.47%
Dr P Belov – QmUL	Dr LM Herz – Oxford	
Senior research fellows	Number: 2	Total: 8.7%
Prof A Geim – Manchester	Prof PF McMillan – UCL	
Career acceleration fellows	Number: 3	Total: 13%
Dr VA Fedotov – Southampton	Dr AL Goodwin – Cambridge	Dr A Kolmogorov – Oxford

Demographics



Based on principal and co-investigators

Functional materials Swot analysis

Strengths

- Good industrial presence for exploitation of functional ceramics
- Functional materials characterisation
- UK Graphene research is world leading (Manchester/Lancaster and Exeter/Bath Science and Innovation awards) and an increasing number of additional groups are moving into this research area
- Good Success on EPSRC/NSF calls
- Good success in recent call for doctoral training centres with 5 awarded within the remit of this portfolio.

Weaknesses

- Relatively low number of first grants, however, success rate for functional ceramics and inorganics first grants is 39%, indicating that the low number of first grants results from a limited number of applications to this scheme
- Search for new functional materials is relatively limited (as highlighted by the International Review of Materials 2008)
- Academic and industrial communities can be fragmented in certain areas.

Opportunities

- Further expansion of international collaborations (e.g. through future EPSRC/NSF joint calls)
- Development of lead free electroceramics following EU legislation requiring the removal of lead from electroceramic materials
- Optimisation of materials for energy (e.g. fuel cell electrodes) and materials for energy storage
- Opportunities to bid into EPSRC mission programmes (e.g. Nanotechnology and Energy).

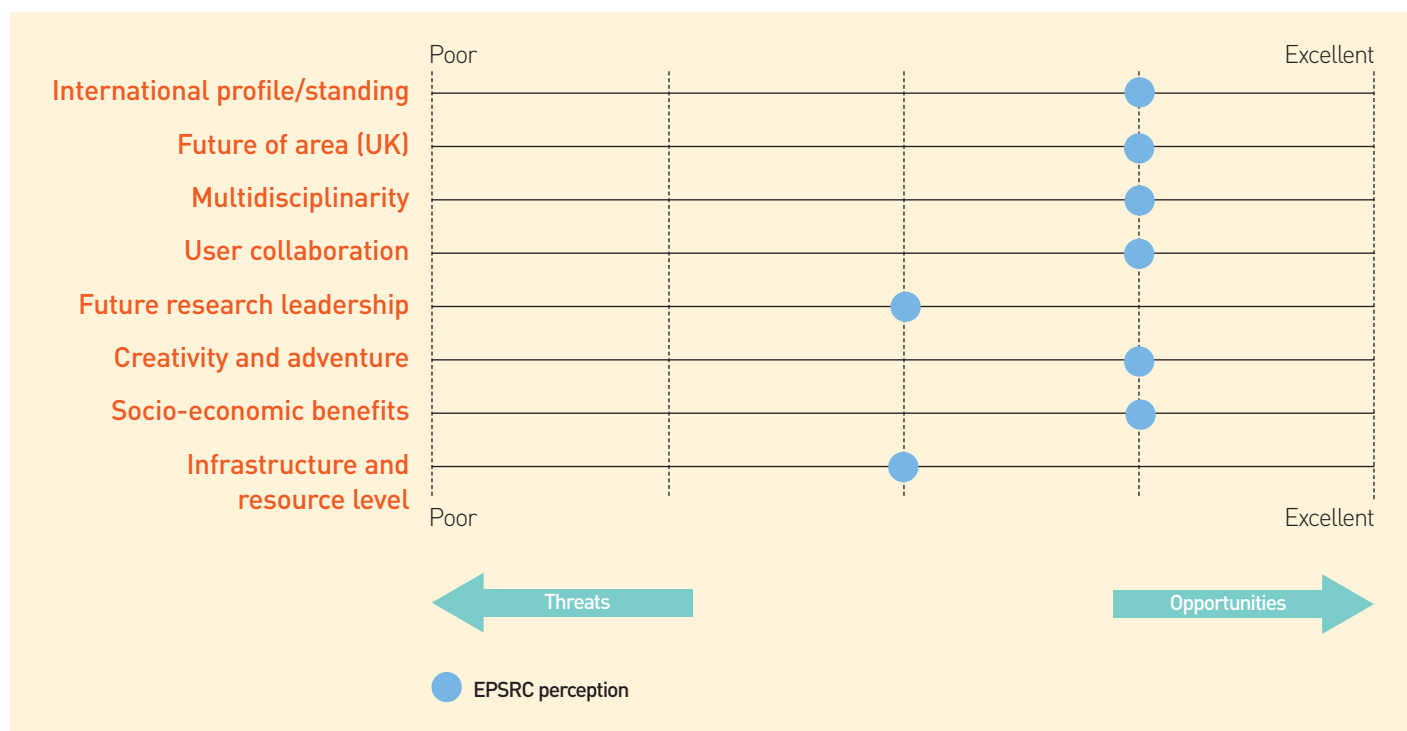
Threats

- Increasing globalisation implies decreasing number of UK controlled manufacture
- Conservative industry within the functional materials remit could be a barrier to collaboration and investment in adventurous research areas
- Research in this portfolio is sensitive to global market fluctuations.



Functional materials Perceptions

Our perception of the current position of UK functional materials research



Summary

In general, research in the functional materials portfolio is healthy. There are a number of world leading research groups and the announcement of five successful DTCs will lead to a new injection of talented graduate researchers into the area, which will inevitably strengthen the future sustainability of research in this portfolio. Functional materials characterisation is a particularly strong area of research and future opportunities are abundant, particularly in the optimisation of materials for energy, materials for energy storage and the development of lead free electroceramic materials, in response to new EU legislation. UK graphene research will continue to develop due to the two recently awarded Science and Innovation awards in this area.

The UK is not world leading in terms of the search for new functional materials and much of the new technology is developed elsewhere (e.g. Asia and US). In order to strengthen this position, UK groups should continue to adopt collaborations with International academic and industrial groups with particular strengths in new functional materials development. International collaborations can be exploited for example through EPSRC/NSF joint materials call, where bids from the functional materials community have so far seen good success. International collaborations will also help combat the threat of increasing industrial globalisation.

There are significant opportunities for functional ceramics and inorganics in the EPSRC mission programmes (e.g. Energy and Nanotechnology) and researchers should be looking increasingly towards calls in these programmes for funding, in addition to the responsive mode mechanism.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC

Engineering and Physical Sciences
Research Council

PHYSICAL SCIENCES PROGRAMME

Structural polymers

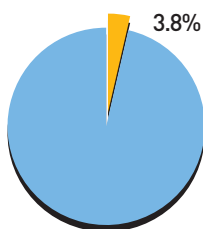
At a glance

The theme Structural Polymers covers research that aims to understand and develop new or novel structural polymers, broadly defined to include almost any non-functional or multifunctional soft solid or organic material. It deals with both synthetic and natural polymers, both commodity and speciality. This theme covers synthesis, characterisation, modelling and theoretical materials research in structural polymers.

Links to other Portfolio Reviews – Structural Materials II, Photonic Materials & Devices, Synthetic Chemistry.

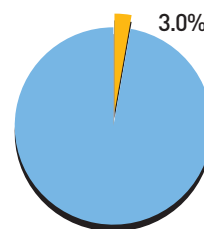
Grants funded

61.2
3.8% of Programme



Grants value

£22.9M
3.0% of Programme

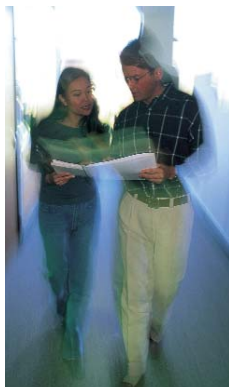


Greatest cross sub-theme connectivity

Synthetic Chemistry – Physical Sciences

Structural Materials II (composites, inorganics, polymers) – M3E

Medical Engineering – M3E



Greatest user collaboration

DSTL

Accelrys Ltd

AWE Plc

BP

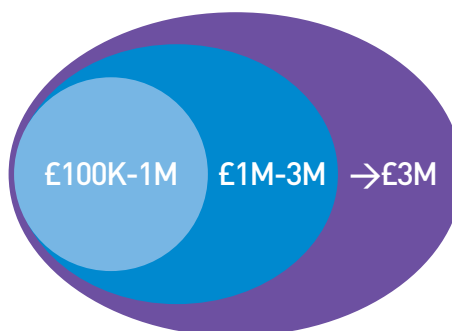
User collaboration is historically strong in the Structural Polymers area

Leading centres based on EPSRC funding

- IRC in Polymer Science – Sheffield, Leeds, Bradford, Durham
- Complex Materials Discovery Portfolio Partnership – Liverpool
- IRC in Microscale Polymer Processing – Leeds, Sheffield, Cambridge, Bradford, Durham, Oxford
- Materials Chemistry Group – Imperial
- Biological & Soft Systems Group and Melville Research Group – Cambridge

Universities within sub theme by EPSRC funding

Light Blue	Dark Blue	Dark Purple
St Andrews	Cambridge	Imperial
Warwick	Sheffield	Nottingham
Durham	Oxford	
Bristol	Manchester	
Swansea	Reading	
QUB	Surrey	
Loughborough	Leeds	
Birmingham	Liverpool	
Bradford	UCL	



Structural polymers

Research capability

Centres for doctoral training

University	Name of centre
Imperial	Training on the theory and simulation of materials DTC
Surrey	Micro- and NanoMaterials and Technologies IDTC
UCL	Molecular Modelling & Materials Science IDTC
Southampton	Complex Systems Simulations DTC

PhD and postdoc fellows

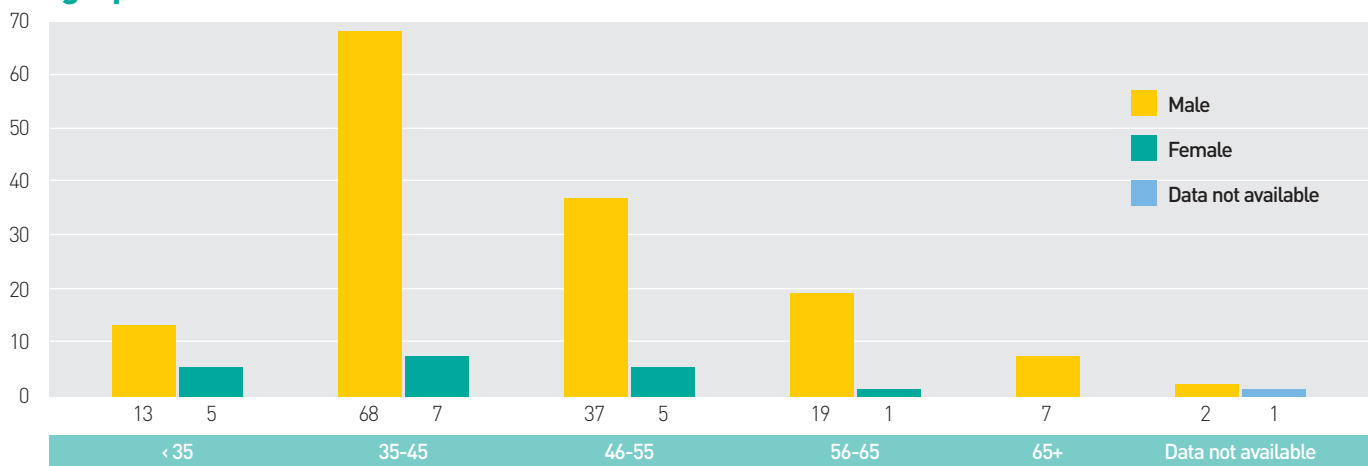
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
75 0.85% of EPSRC total	0.5



Fellowships

Advanced research fellows	Number: 5	Total: 1.4%
Dr E Sivaniah – Cambridge	Dr CK Williams – Imperial	Dr S Krause – QMU London
Dr T Drage – Nottingham		Dr SJ Cooper – Durham
Career acceleration fellows	Number: 1	Total: 5.65%
Dr RK O'Reilly – Warwick		
Leadership fellows	Number: 1	Total: 4.35%
Dr M Shaffer – Imperial		

Demographics



Based on principal and co-investigators

Structural polymers

Swot analysis

Strengths

- A spread of demographics with a healthy number of investigators classed as 'mid-career'
- Strong demand for early career funding including 10 funded First Grants
- Four CDTs/IDCs in this area
- Community is engaged in all EPSRC schemes and shows an interest in larger grants
- High proportion of grants incorporating user collaboration, resulting in research with high impact
- Recent joint EPSRC/NSF call for Material World Network proposals generated high demand
- Large amount of inter-disciplinary work, covering a wide range of areas – chemists, life scientists, physicists and engineers working with materials scientists
- Several centres of expertise which while initially funded by EPSRC are now maintained by the community.

Weaknesses

- Whilst there is strong innovation and good links to industry in biomedical, pharmaceutical and optoelectronic applications, there is a decline in the industry user base in commodity polymers and this could have an impact upon future research funding in this area.

Opportunities

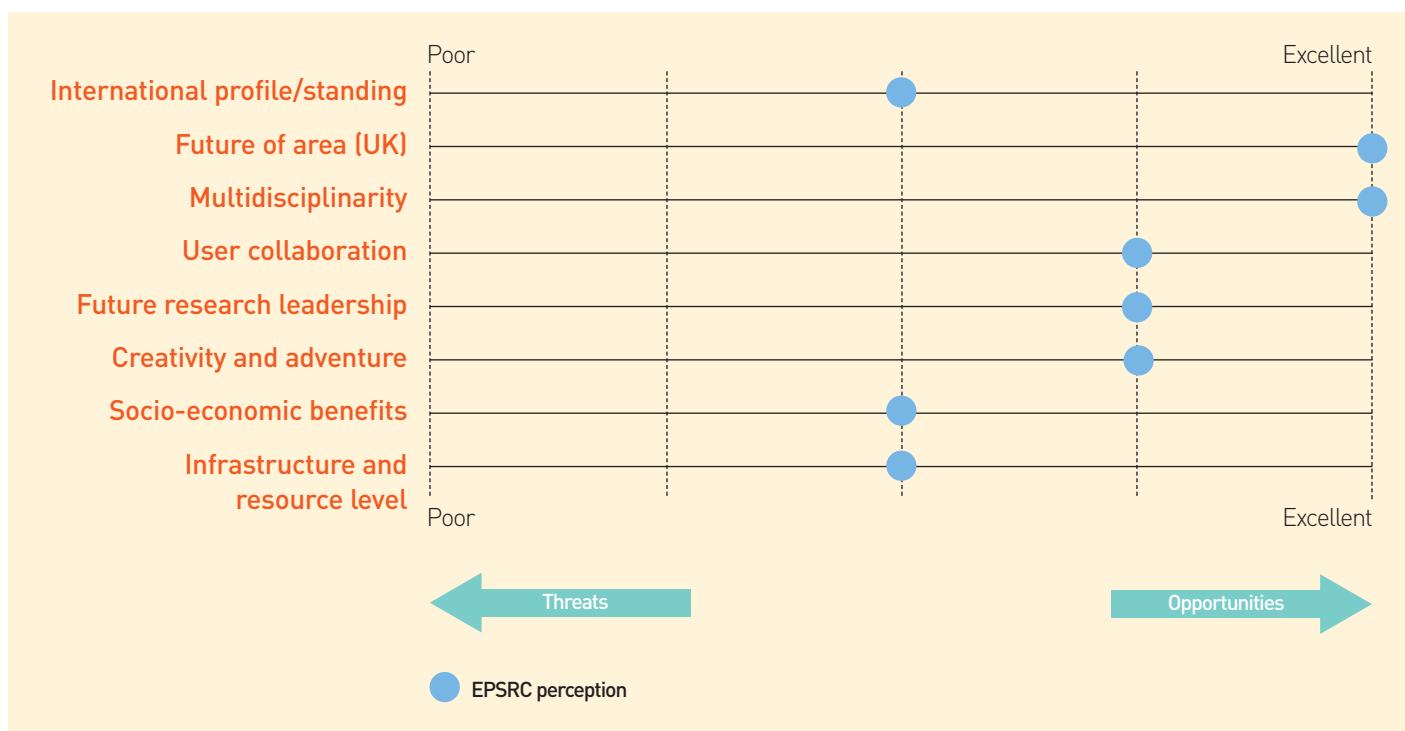
- EPSRC are developing Materials Challenges with the community to identify new research and application areas
- Opportunities for funding exist in the Mission Programme Themes for example Next Generation Healthcare and Energy
- Need to build on excellence in modelling and analysis to maintain innovation.

Threats

- Lack of support from industry during recession
- Fluctuating commodity feedstock costs for industry
- Increased focus and alignment of research and industrial goals may lead to reduced innovation in some areas in the long term; this concern was raised by the 2008 Materials International Review.



Our perception of the current position of UK structural polymers research



Summary

The Structural Polymer portfolio is a vibrant research area with a good spread of demographics and a high number of investigators in the mid-career group. These demographics combined with four DTCs awarded in materials research bode well for the future of the area.

In terms of research output, research in speciality polymers is healthy, for example drug delivery, but research into commodity polymers is declining. This will have an impact on SMEs in the coatings, construction and packaging industries that rely on continued innovation in the material and processing of structural polymers.

Industrial collaboration is historically strong in the Structural Polymers portfolio with research grants being supported by cash or in-kind contributions from a range of industrial partners and many more investigators securing letters of support from industry.

Cross-disciplinary research is the natural approach for investigators working in materials with structural polymers research crossing Physics, Chemistry, Chemical Engineering and Life Sciences interfaces. This should be maintained and could be stimulated by further engagement in the Mission Programmes for example Next Generation Healthcare and Energy where the community has already shown interest.

The recent Materials International Review commented that the international profile of UK structural polymer research is low when compared with the potential significance of the area, this could be improved by increasing international collaborations and encouraging researchers to benchmark themselves internationally rather than nationally.

Recession and reduction in industry may affect this research area significantly more than others in the Physical Sciences Programme with a reduced ability to produce spin-out companies and form collaborations with industry, although lack of industrial opportunities may lead to an increase in PhD numbers and more students staying on in University research in the short term.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC
Pioneering research
and skills

PHYSICAL SCIENCES PROGRAMME

Surface science

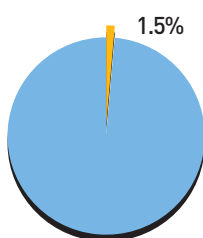
At a glance

This theme covers the study of surfaces, surface probes and interfaces. Techniques include x-ray and electron diffraction, synchrotron radiation and scanning probe microscopy also the study of surface mediated chemical reactions and surface adsorbed species.

Much of traditional surface science has transformed into other areas which appears in other portfolio reviews such as catalysts and nanotechnology.

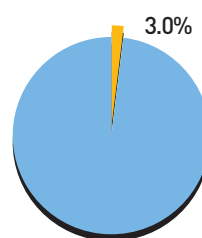
Grants funded

24.8
1.5% of Programme



Grants value

£16.5M
3.0% of Programme



Greatest cross sub-theme connectivity

Life Science Interface
M3E
Nano Characterisation



Greatest user collaboration

Optopreneurs Ltd
Microsharp Corporation Ltd
Institute for Molecular Manufacturing
DSTL

Leading centres based on EPSRC funding

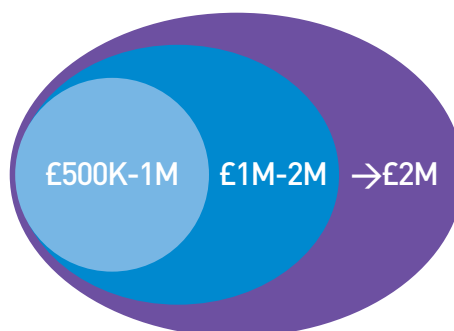
- UCL, Science and Innovation Award, Prof DW McComb
- Strathclyde, Science and Innovation Award, Prof D Birch
- Cranfield, IKC, Prof P Shore

Universities within sub theme by EPSRC funding

Sheffield
Oxford
Nottingham
Trent

Manchester
Liverpool
STFC
Warwick

Nottingham
Imperial
Cranfield
Cambridge
Edinburgh
UCL
Strathclyde



Surface science Research capability

PhD and postdoc fellows

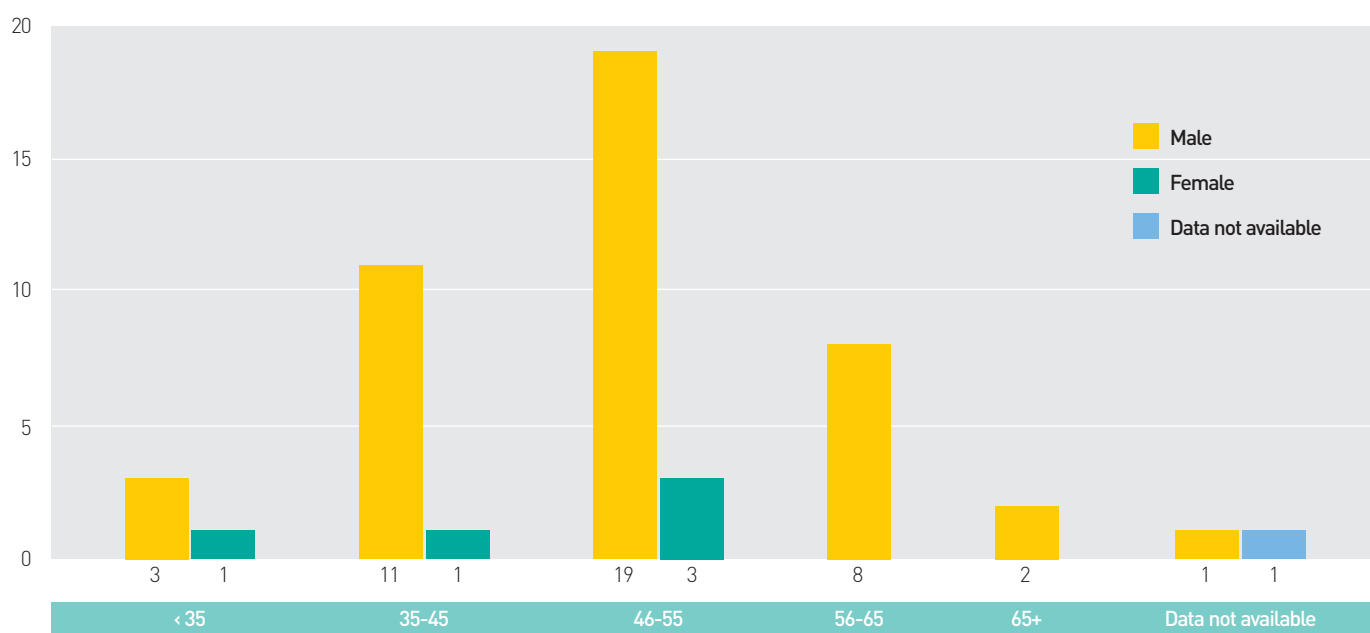
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
48 0.5% of EPSRC total	N/A



Fellowships

Leadership fellows	Number: 1	Total: 4.3%
Prof P Moriarty – Nottingham		

Demographics



Based on principal and co-investigators

Surface science

Swot analysis

Strengths

- There are a healthy number of mid-late career researchers and some research activity which can be classed as internationally leading
- Investment in infrastructure has led to a number of well-equipped labs and researchers have access to good central facilities
- There is a focus on inter-disciplinary research, particularly crossing the chemistry and life sciences borders
- 'Traditional' Surface Science has branched out over the years and into many areas including nanotechnology, catalysis, magnetic materials and quantum information processing.

Weaknesses

- Traditional surface science is generally not perceived to be an attractive subject to young researchers. Many new researchers are attracted to other related but separate areas such as nanotechnology, and this is borne out by the low number of early career researchers and fellows in this area
- When considering proposals sent to responsive mode panels creativity and adventure is perceived to be rather low when compared to other areas in the physical sciences portfolio. This may be due to more innovative research being funded in other areas which surface science contributes to.

Opportunities

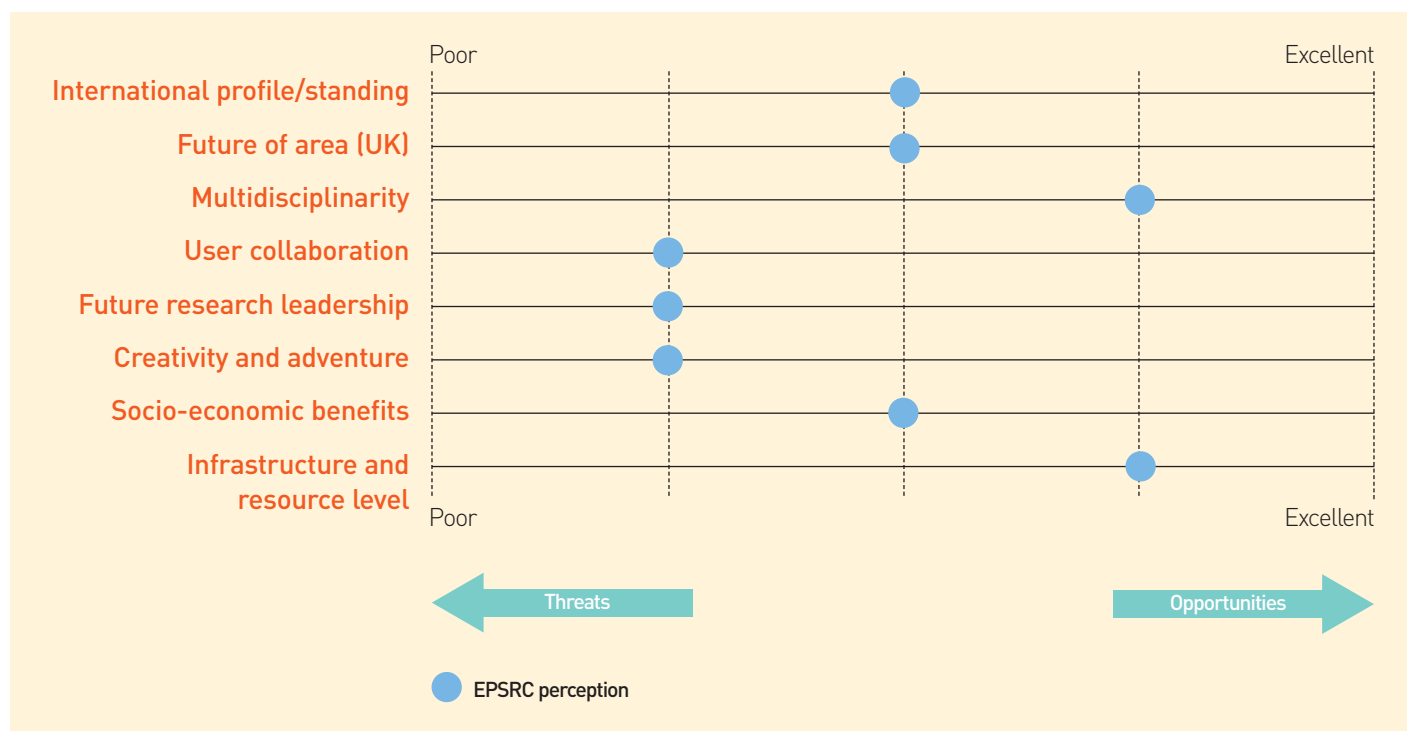
- There are opportunities to improve user collaboration through greater industrial exploitation of outputs of surface science
- There are opportunities to further strengthen inter-disciplinary collaborative research
- The recent Nobel Prize award to Gerhard Ertl in this area may bring renewed interest
- Equipment sharing initiatives could be used to overcome the high cost barrier associated with setting up well equipped labs from scratch.

Threats

- Whilst there are internationally competitive researchers in the 35-65 year age range, there are few new researchers in this portfolio which may result in deterioration in leadership capacity
- Running an experimental group in Surface Science is very expensive requiring sustained investment. This may be prohibitive to many young researchers and this could have a negative effect on the future of the discipline.



Our perception of the current position of UK surface science research



Summary

Much of the work traditionally carried out in the area of surface science has successfully progressed into other areas which are not represented in this portfolio review such as catalysis, nanotechnology and engineering.

Although there are some talented researchers of high international standing there is still significant room for improvement in order to compete with the best in Europe. It is felt that the area could be strengthened by attracting researchers who will be innovative and creative future leaders. One current barrier to this is the expense of setting up an experimental laboratory in this field. There may be opportunities through equipment sharing initiatives to rectify this.

There is a focus on inter-disciplinary research crossing the chemistry and life sciences borders and this should be encouraged and strengthened. There are also opportunities to initiate greater user engagement and collaboration which could increase the impact and outputs of the research.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

EPSRC
Pioneering research
and skills

PHYSICAL SCIENCES PROGRAMME

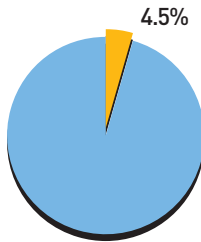
Structural ceramics and inorganics

At a glance

This sub-theme covers the research areas of synthesis, growth and characterisation of structural ceramics and inorganics, including theoretical materials science of structural and inorganic materials.

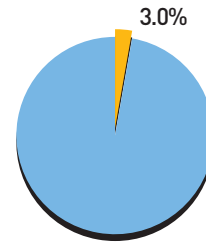
Grants funded

72
4.5% of Programme



Grants value

£29M
3.0% of Programme



Greatest cross sub-theme connectivity

- Structural materials I (metals and alloys) (M3E Programme)
- Structural materials II (composites, inorganics, polymers) (M3E programme)
- Bioprocess engineering (M3E Programme)



Greatest user collaboration

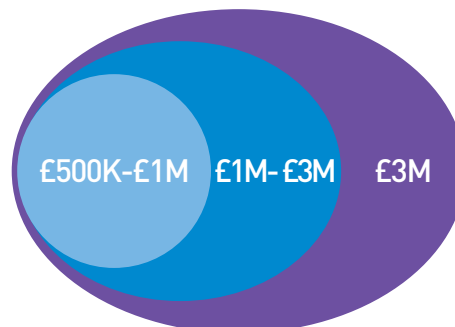
- DERA/DSTL/QinetiQ
- Fraunhofer
- EURATOM/UKAEA Fusion Association
- Surface Transforms
- Calcarb

Leading centres based on EPSRC funding

- Imperial, Science and Innovation Award, Centre for Structural Ceramics
- Sheffield, Ceramics and Composites Laboratory, Research Centre in Surface Engineering
- UCL, Centre for Materials Research, Materials Chemistry Centre

Universities within sub theme by EPSRC funding

Bath	Manchester	Sheffield
Birmingham	UCL	Imperial
Newcastle	Bristol	
Edinburgh	Cambridge	
Nottingham	Oxford	
Southampton	Warwick	



Research capability

Centres for doctoral training

University	Name of centre
Imperial	Theory and simulation of materials DTC
Surrey	Micro- nanomaterials and technologies IDTC

PhD and postdoc fellows

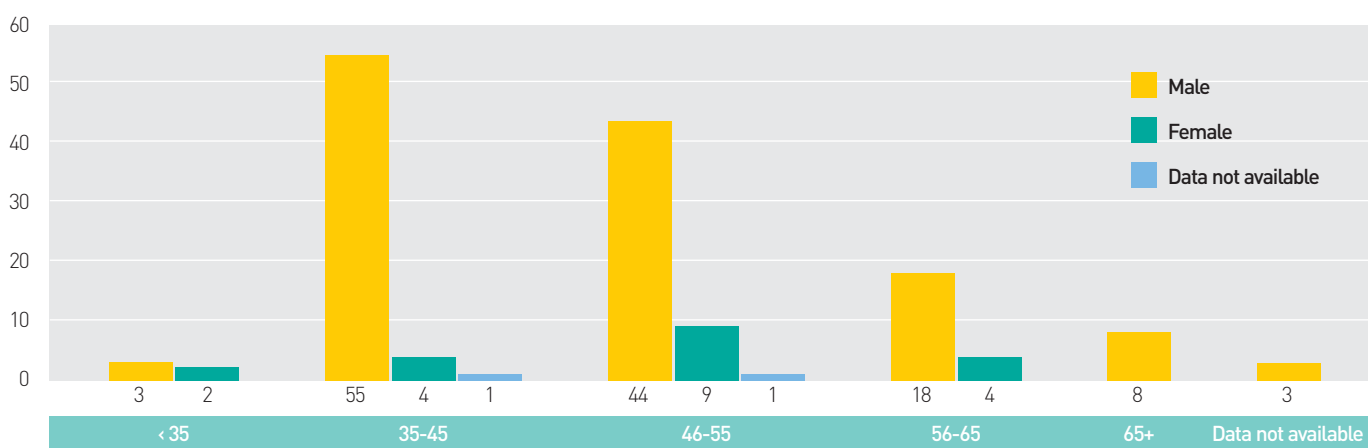
Total PhD studentships (all EPSRC sources)	Number of postdoctoral fellows
64 0.73% of EPSRC total	1



Fellowships

Advanced research fellows	Number: 4	Total: 1.9%	
Dr D Walsh – Bristol	Dr S Zhang – Sheffield	Dr Y Zhu – Nottingham	Dr K Trachenko – Cambridge
Career acceleration fellows	Number: 1	Total: 4.3%	
Dr E Bichoutskaia – Nottingham			

Demographics



Based on principal and co-investigators

Swot analysis

Strengths

- Multi-disciplinary collaborations
- Ceramics characterisation and characterisation techniques
- Relatively strong international links
- Imperial Science and Innovation award 'Building new capability in structural ceramics'
- Structural Ceramics Network (SCERN).

Weaknesses

- Recruitment of early career academics – not helped by relatively low number of studentships and shortage of undergraduate material scientists
- Researchers find it difficult to think quantitatively about impact (as noted in the International review of materials 2008).

Opportunities

- Opportunities in new technologies for power generation
- Military technologies
- Nanomaterials
- Expansion of international collaborative efforts (eg. Through Materials EPSRC/NSF joint call)
- Development of environmentally sustainable structural ceramics materials and synthetic routes
- New biomaterials for medical applications.

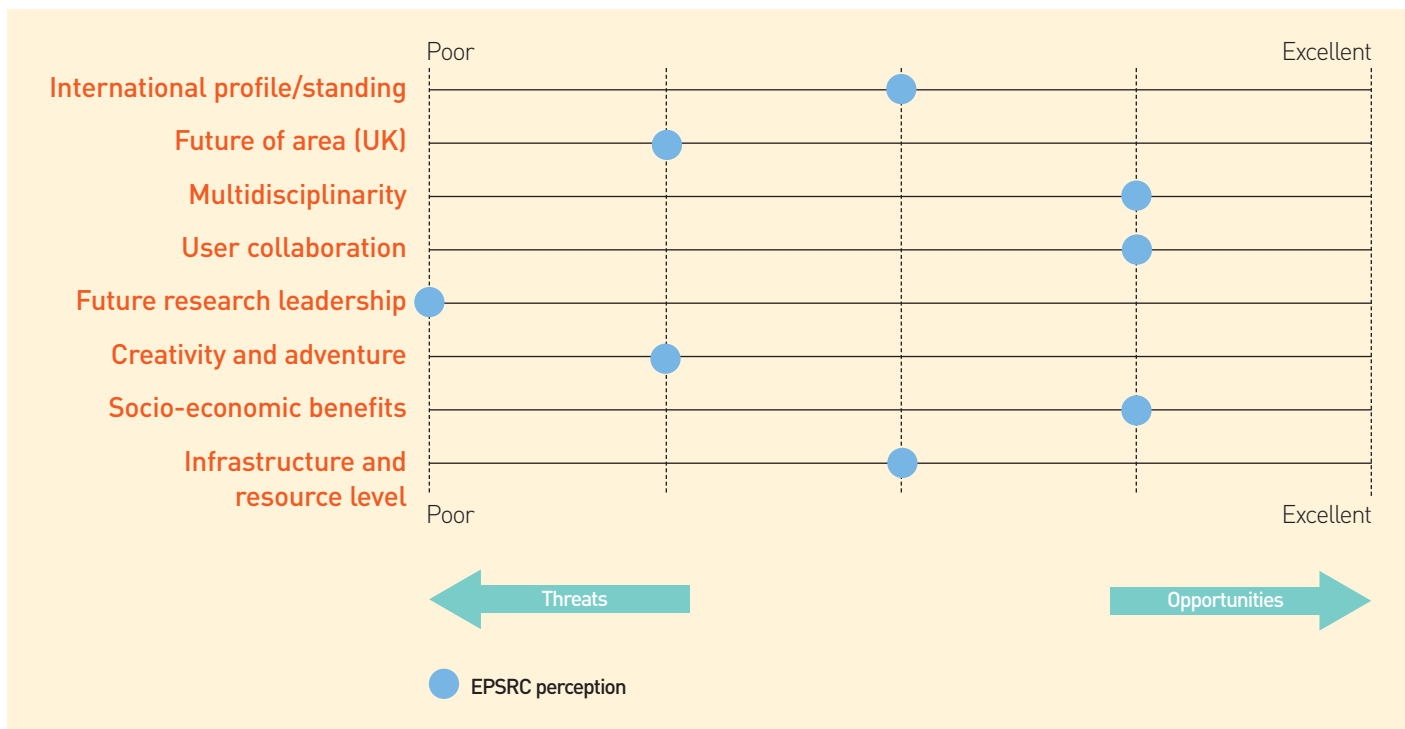
Threats

- Lack of new researchers coming into the area
- UK not competitive with other world leading groups in structural ceramics research
- User relocation overseas.



Perceptions

Our perception of the current position of UK structural ceramics and inorganics research



Summary

The structural ceramics and inorganics portfolio is highly multidisciplinary in nature with good user collaborations. Characterisation of structural materials and characterisation techniques are particularly strong in this portfolio. The structural ceramics network (SCERN) has had good success in recent years in improving communication within the previously fragmented structural ceramics community. There are a number of future opportunities for structural ceramics and inorganics, for example in new technology for power generation, military materials, nanomaterials and biomaterials.

Despite strength in some areas, in general, the UK is not world leading in structural ceramics and inorganics research due to a tendency towards incremental research. The science and innovation award at Imperial in 'Building New Capability in Structural Ceramics' may help to address this to some extent and the UK should further strengthen its position by expanding international collaborations and interactions within both academic and user communities. Strengthening the UK research position will help to attract new researchers and address the most significant threat to this area which lies within the difficulty in recruiting early career academics. This may be also addressed in some part by the new IDC (Surrey) and CDT (Imperial) by training postgraduates in materials science, however the challenge will come in retaining these students within academia following their training. Support from experienced colleagues is vital in the transition period from postgraduate to academic especially when early career researchers are applying for first grants and fellowships. Outreach programmes should be encouraged as a method for promoting materials science to potential undergraduates.

Engineering and Physical Sciences Research Council

Polaris House
North Star Avenue
Swindon
SN2 1ET
www.epsrc.ac.uk

