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Global Expert Mission
Advanced Materials in South Korea 2018

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Welcome

Innovate UK's global missions programme is one of its most important tools to support the UK's Industrial Strategy's ambition for the UK to be the international partner of choice for science and innovation. Global collaborations are crucial in meeting the Industrial Strategy's Grand Challenges and will be further supported by the launch of a new International Research and Innovation Strategy.

Innovate UK's Global Expert Missions, led by Innovate UK's Knowledge Transfer Network, play an important role in building strategic partnerships, providing deep insight into the opportunities for UK innovation and shaping future programmes.

In March 2018, a UK delegation supported by British Embassy staff travelled to South Korea and met with government officials, academics and commercial entities. The UK's Advanced Materials Mission gained exposure to nearly twenty advanced materials-related organisations and learnt about the relevant programmes supporting advanced materials research and development that could directly benefit collaboration, joint ventures and growth opportunities for organisations in the UK.

In this publication, we share the information and insights gathered during their time in South Korea.

1. Introduction

The global market for materials is large, soon estimated to exceed over US$4.9 trillion per annum[1], and in particular, advanced materials are vital to current and future UK manufacturing and service sectors. Key UK sectors, such as aerospace, automotive, construction, electronic equipment, energy, medical equipment, packaging, rail and their supply chains all need materials to deliver bulk and niche products. Furthermore, they require continuous innovation in materials and processes to maintain the development of products to meet future market requirements such as in lightweight and multi-functional applications.

Examples of advanced materials can be found in graphene-based products as well as; other 2D materials, advanced composites, nanotechnology, liquid crystals, semiconductors, superconductors, optics, lasers, sensors, porous materials, light emitting materials, technical ceramics, biological materials, magnetic materials, thin films, colloids, energy materials, photovoltaics, solar cells, biomaterials, photonics, ferroelectrics, multiferroics, metamaterials, drug delivery, cancer therapy, tissue engineering, imaging, self-assembly, hierarchical materials, batteries, super-capacitors, thermo-electrics, polymers, nanomaterials, nanocomposites, nanotubes, nanowires, nanoparticles, carbon, diamond, and fullerenes.

South Korea is the eleventh largest economy in the world and fourth largest in Asia. The country has a heavy reliance on exports, which account for more than 40% of its gross domestic product (GDP). The primary industries including automotive, shipbuilding, electronics, textiles and steel contribute to nearly 40% of South Korean exports. The economy is heavily supported by large family-owned conglomerates, known as chaebols, with the largest being Samsung[2], SK[3], Hyundai[4], LG[5] and Lotte[6].

In 2015, South Korea spent 4.23% of its GDP on research and development (R&D), second only to Israel in the world. Almost three-quarters of the R&D is business-led, of which 90% is invested in manufacturing. The South Korean government plans to increase spending on science and technology R&D projects by 26% in 2018. The Ministry of Science and ICT[7] (formally the Ministry of Science, ICT and Future Planning), headquartered in Gwacheon, will spend KRW1.52 trillion (US$1.38 billion) in 2018 on such R&D projects. Figure 1 shows its R&D spend allocation by sector in 2017.

[1] https://ktn-uk.co.uk/news/innovate-uk-optimat-release-materials-landscaping-study
[2] www.samsung.com
[3] www.sk.co.kr
[4] www.hyundai.com/worldwide/en/global-hyundai/hyundai-world-wide
[5] www.lg.com/global
[6] www.lotte.co.kr
[7] english.msit.go.kr/english/main/main.do

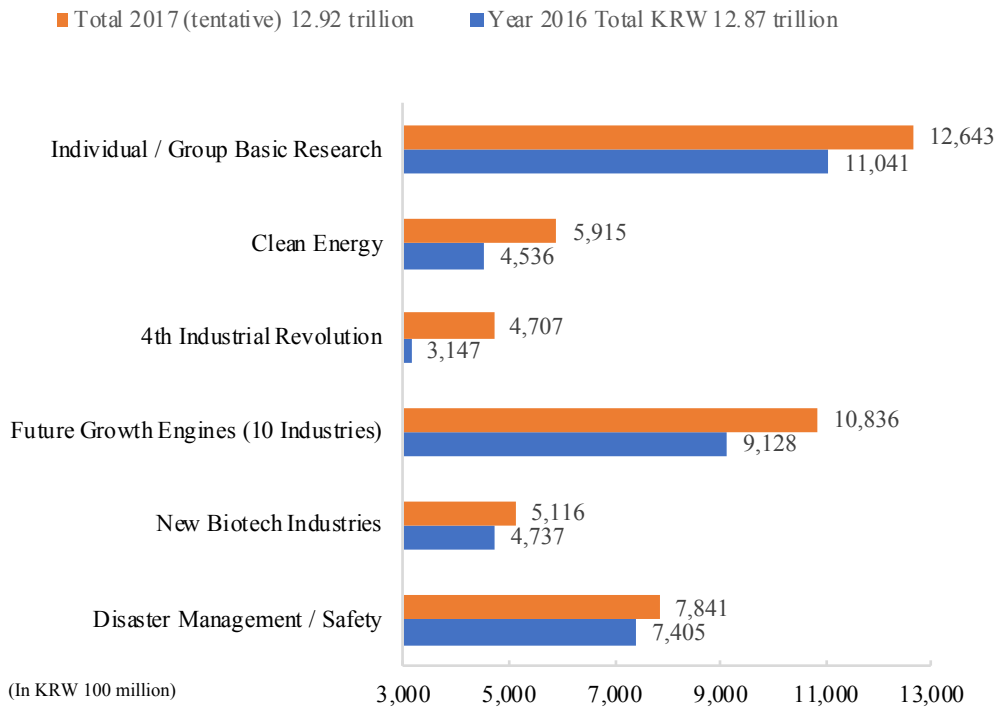


Figure 1. Government budget by R&D sector, adapted from Invest Korea. Original source; Korean Ministry of Science, ICT and Future Planning, and Ministry of Strategy and Finance.

In the past, the South Korean government has acknowledged that while the country has a very high public R&D expenditure, it is not always so successful at commercialising fundamental research. The central pillars of the government's current R&D Innovation Plan[8] are the reorganisation of R&D support systems to place greater emphasis on small and medium-sized enterprises (SMEs) and the creation of a user-oriented optimal environment for research, facilitated in part by the creation of the Ministry of SMEs and Start-ups in 2017. This plan aims to further strengthen competitiveness and support the innovation of SMEs. The government also intends to support innovation and make South Korean R&D more successful by increasing international partnerships.

In recent years, South Korea has increasingly been engaging with the EU in research and innovation. For example, by taking part in Horizon 2020[9], with several topics in the 2018-20 work programme explicitly encouraging cooperation with South Korea. Materials-related topics include:

- Risk governance of nanotechnology.
- Nano informatics: from materials models to predictive toxicology and ecotoxicology.
- Unconventional nanoelectronics.

There has also been direct collaboration between the UK and South Korea. For example, in 2016, the UK's Advanced Manufacturing Research Centre[10] (AMRC) launched AMRC Asia[11] in Gyeongsan City. It is a joint project involving the AMRC in the UK, the Korea Institute of Carbon Convergence Technology[12] (KCTECH), and other high-value Korean manufacturing R&D institutes and companies.

[8] https://english.msit.go.kr/cms/english/pl/policies2/__icsFiles/afieldfile/2015/11/11/Government%20RnD%20Innovation%20Plan.pdf
[9] ec.europa.eu/programmes/horizon2020
[10] www.amrc.co.uk
[11] www.amrc.co.uk/blog/amrckorea
[12] www.kctech.re.kr

2. Industrial Strategy for Advanced Materials in South Korea

South Korea has been ranked first overall on the Bloomberg Global Innovation Index (GII) since 2013[13]. In 2018, South Korea was first in patent activity, second in R&D intensity, second in value-added manufacturing and third in tertiary efficiency. By comparison, the UK ranked seventeenth on the same index, achieving fifteenth in patent activity, twentieth in R&D intensity, fortieth in value-added manufacturing and eighth in tertiary efficiency.

South Korea has experienced a reduction in its exports since 2010 as a result of China's increased self-sufficiency. The South Korean government recognises that it must seek opportunities and realign its capabilities so that it can remain globally competitive. There is a need to nurture new industries and to advance the capabilities of established industries, with a substantial shift in focus from low-value, mass-produced goods to high-value manufacturing (HVM).

A Materials and Component Industry Policy[14] has been in place since the 1970s. It started with a no import localisation policy supported by guarantees and affordable finance to encourage local purchasing and manufacturing. According to KIAT[15], the First Basic Plan for the development of materials and components was launched in 2001, and the strategy has since progressed through a series of Basic Plans. After the completion of a capacity building phase in 2012, the focus shifted to the development of future-oriented cutting-edge materials leading to the launch of the Fourth Basic Plan.

The First Basic Plan, delivered between 2001 and 2008, had a vision for South Korea to become a supply hub for materials and components. The objective was to increase domestic production to reduce trade deficits by localising general purpose materials and components production in South Korea. This was followed by a Second Basic Plan, with a revised vision for South Korea to become recognised as one of the top five nations for materials and components by 2012, and to achieve technology levels of the advanced nations. In 2013, the Third Basic Plan was developed to build on South Korea's increased technological capabilities and improve their international standing to be in the top four for materials and components by 2020.

The Fourth Basic Plan is now in place with a timeframe of 2017-2021 and has the objective of placing South Korea amongst the world's top exporters in advanced materials and components. Success will be demonstrated by having 100 world-leading advanced material and component technologies and techniques by 2025. There are four main strategic aims to achieve this vision:

Materials and Components Vision: Four Strategic Aims

1	Develop 100 new materials and component technologies by 2025 and be recognised as one of the top four materials and component exporters in the world by mobilising government's capacity to develop the new materials and components.
2	Enhance support for restructuring so that industry is ready for the 4th Industrial Revolution. Expand the ecosystem to support the development of converged/integrated materials and components by enhancing the technological capabilities of SMEs and strengthening local R&D innovation capabilities. Establish a training system for people engaged in the new high-tech materials and components industry.

[13] www.bloomberg.com/news/articles/2018-01-22/south-korea-tops-global-innovation-ranking-again-as-u-s-falls
[14] https://www.wto.org/english/res_e/reser_e/wts_future2013_e/ahn.pdf
[15] https://www.kiat.or.kr/site/main/publish/view.jsp?menuID=002002006

3	Build a high efficiency, eco-friendly production system for the materials and component industry to support the efficiency of SMEs and the development of eco-friendly methods of sourcing core materials.
4	Strengthen the global competitiveness of materials and component companies, through an expansion in international cooperation, an increase in advancement support, further investment in mergers and acquisition support, and a track record of successful demand-oriented and corporate collaboration.

To support these strategic aims, the government extended a special loans programme for a further ten years to encourage materials and components development that will match future needs. Support is available to all businesses to achieve the vision of the Materials and Components Strategy, but the focus is on helping SMEs and the development of a supply chain network capable of supporting the needs of the materials industry in the future.

Innovation funding in South Korea is de-centralised with most government ministries having their own R&D programmes. The ministries of most relevance to the advanced materials sector are the Ministry of Science and ICT[16], Ministry of Trade, Industry and Energy[17], Ministry of SMEs and Start-ups[18] and the Ministry of Health and Welfare[19].

2.1 R&D in South Korea

A recent OECD report[20] stated: "*While Korea's public R&D expenditure is high, it still has few world-class universities and produces few high-impact publications in comparison to peers. One reason is that the public research system has historically been skewed towards applied and development-oriented research, much of which is performed in the public research institutes (PRIs) that supply technology for industrial R&D. The government has increased investment in basic research, from 30% of total government R&D investment in 2008 to 36% in 2015, with a target of 40% by 2017. At the same time, the government is encouraging the PRIs to leverage funds from collaboration with the private sector and to develop industrial technology research contracts*."

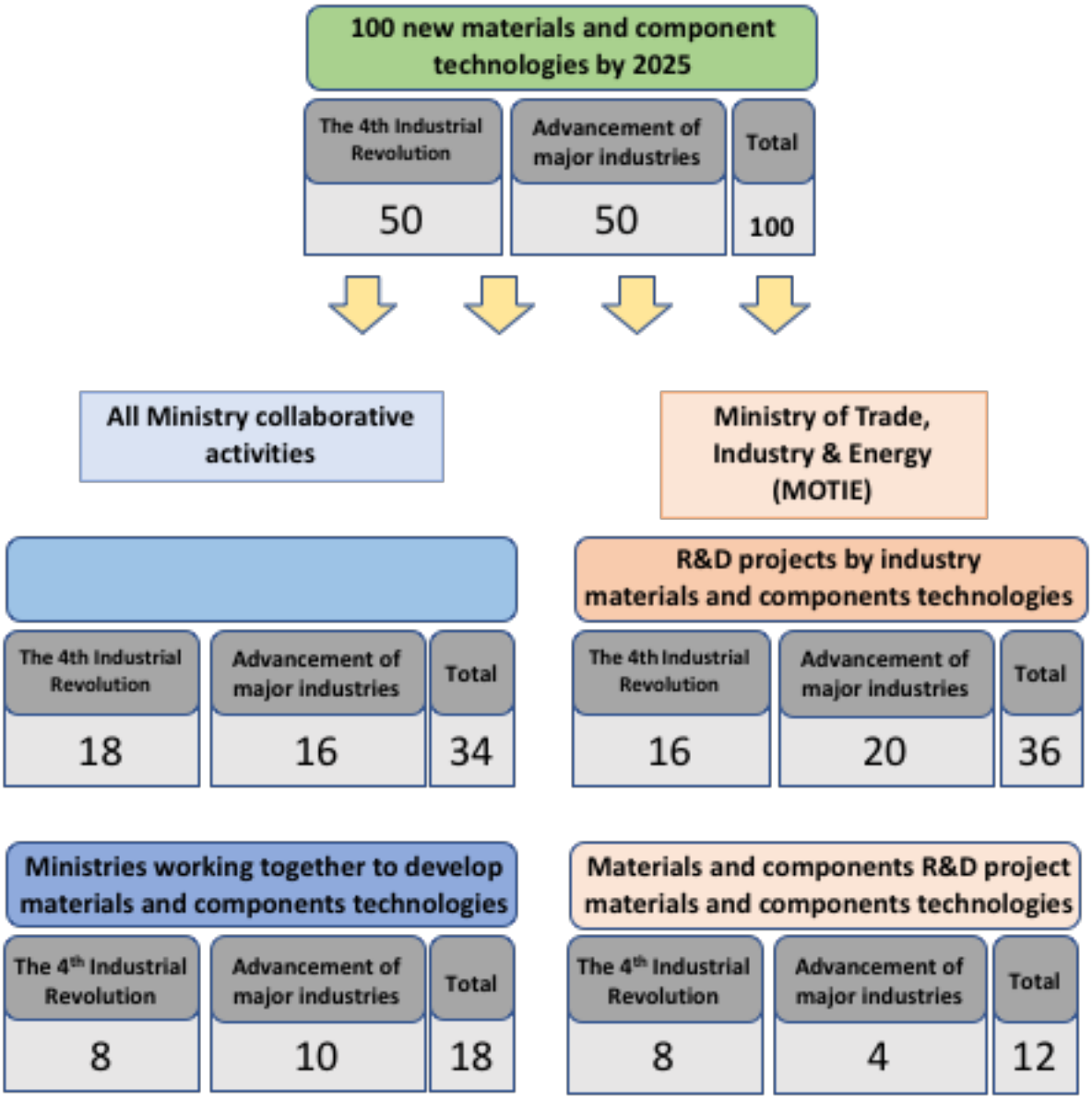
In South Korea, industry operates at a breakneck pace and there is a significant amount of emphasis on speed to market, which brings with it an intense pressure to innovate. The R&D process is undertaken quickly with iterative design steps and decisiveness to achieve fast product development cycles. For advanced materials, there is a drive to go beyond conventional technologies and to be a leading producer of advanced materials.

South Korea has a world-leading ability in applied research but lacks the knowledge and capabilities needed to undertake fundamental research. They are therefore keen to engage with potential partners and sources of R&D worldwide. There are some notable areas of world-class R&D, such as Seoul National University's work on graphene-related synthesis and applications.

Research and development strategies are driven from the top down with a national programme in place. According to KIAT, the target of developing 100 new materials and component technologies by 2025 was established after consultation with national research institutes, along with an agreement to create a "roadmap for the development of new high-tech materials and components by the end of 2025[21]". The roadmap defines a split in the development of new materials and components to satisfy the needs of Industry 4.0 (the 4th Industrial Revolution) and to advance the capabilities of existing industries. Figure 2 describes the structure adopted by the South Korean government for the delivery of the Fourth Basic plan.

[16] english.msip.go.kr/english/main/main.do
[17] http://english.motie.go.kr/www/main.do
[18] www.mss.go.kr/site/eng/main.do
[19] www.mohw.go.kr/eng
[20] www.oecd.org/china/G20-innovation-report-2016.pdf
[21] https://www.kiat.or.kr/site/engnew/activities/components.jsp

Figure 2: Structure of the Fourth Basic Plan



Source: *Korea Institute for Advancement of Technology (KIAT)*

2.2 Key Innovation Stakeholders Engagement in Expert Mission

2.2.1 Hyundai Motor Group (R&D Facility)

Hyundai Motor Group[22] is the largest car manufacturing company in South Korea and the fourth largest in the world (9% market share of the global automotive industry). The company also owns 33% of Kia Motors and sells the luxury car brand Genesis.

Hyundai aims to become the second largest alternative powertrain automaker by 2020. It is developing electric, hybrid and hydrogen fuel cell vehicles. The company recently joined a global initiative, the "Hydrogen Council" to promote the development of fuel cell vehicles. Hyundai is a latecomer to the production of self-driving vehicles, ranking tenth out of eighteen global car manufacturers developing autonomous driving systems.

In February 2017, the company established a Strategy & Technology Division to oversee research into future technologies such as AI, advanced materials, energy, robotics and next generation ICT. The company is also supporting innovation externally with Hyundai CRADLE[23], the Centre for Robotic-Augmented Design in Living Experiences (formally Hyundai Ventures). CRADLE's strategic investments focus on five themes:

- Robotic and intelligent systems
- Eco-friendly technologies
- Mobility services
- Materials and manufacturing technology
- New vehicle concepts.

2.2.2 Hanwha Advanced Materials

Hanwha Advanced Materials[24], part of the Hanwha Group[25], produces lightweight composite materials and thermoformable components for the automotive industry, advanced films for solar cells and coating films for mobile phones and displays. It produces automotive parts for a wide range of automakers, including Hyundai, Kia, BMW, Volkswagen, GM, Ford and Toyota.

The company has production and R&D sites in South Korea, the US, Europe and China. It is growing rapidly and plans to increase the number of overseas corporations to more than ten by 2020.

The Lightweight Composite Materials R&D Centre[26] was opened in 2015 and focuses on thermoplastics for automobiles and thermosetting composite materials as well as new methods of construction. The types of composites and plastics currently produced include glass-mat thermoplastics (GMT), lightweight reinforced thermoplastic (LWRT), expanded polypropylene (EPP), high strength fibre reinforced sheet moulding composite (SMC) and long fibre thermoplastics (LFT). Hanwha Advanced Materials is now expanding into solar power, electronics, next-generation mobile communications and the Internet of Things.

2.2.3 Korea Institute of Science and Technology (KIST)

The Korea Institute of Science and Technology[27] (KIST) is a government-supported research institute, founded in 1966 as the country's first science and technology research institute. With an annual research budget of US$450 million, KIST focuses on R&D in government-directed areas of interest aligned with the government strategies and has over 80 partner institutes around the world, including in the US, Japan and Germany.

KIST has a significant portfolio of process and analytical equipment that can measure down to sub-nanometre level. This equipment can be accessed by SMEs. The institute presents itself as a one-stop-service for the evaluation and development of nanocarbon composites and carbon fibre reinforced polymer (CFRP) composites for industry. The Materials and Life Sciences Research Division was established to merge nanotechnology, biotechnology, and informational technology through multidisciplinary research as well as build platforms for research that combines various conventional technologies, in the hope of these leading to the development of advanced and core technologies.

KIST is seeking to create a platform for collaboration with other countries. The institute has some interaction with the Fraunhofer Institutes, and established KIST Europe[28], an office in Saarbrucken, Germany in 1996. The German office is designed to be an access point to R&D projects and sources of partnership opportunities and funding.

KIST is keen to engage with the UK and in developing a relationship with UK organisations. KIST would like access to the UK market as well as UK-based companies with a global reach in sectors such as automotive. From a UK perspective some specific technologies are being developed that could be of interest to UK organisations, examples being:

[22] www.hyundaimotorgroup.com/Index.hub
[23] www.cradleinc.com
[24] www.hanwha.com/en/products_and_services/affiliates/hanwha_advanced_materials.html
[25] www.hanwha.com/en.html
[26] http://hwam.co.kr/en/company/rnd-intro.do
[27] eng.kist.re.kr/kist_eng/main
[28] www.kist-europe.de

- Double-sided transparent displays
- Graphene Cu composite wire
- Biocompatible glass carrier with healthcare applications
- Gas sensor technology based on single-walled carbon nanotubes (SWCNT) with amine functionalisation
- Low-temperature activated environmental catalyst for different applications across sectors
- 2D quantum dot technology.

2.2.4 Seoul National University

Seoul National University[29] (SNU), founded in 1946, is considered to be the most prestigious university in the country. It has 16 colleges and 10 professional schools. The Expert Mission visited its Graphene Research Laboratory[30], whose research interests include nanomaterials synthesis, nanofabrication and characterisation, nano-analysis and quantum mechanics, and molecular dynamics simulation. The lab is led by Professor Byung Hee Hong who pioneered the large-scale Chemical Vapour Deposition (CVD) synthesis of graphene and is globally recognised as a leading academic in his field of research.

Professor Hong's presentation to the delegates demonstrated a clear vision and realistic route towards the commercialisation of graphene. His team has made significant contributions to the field – both in terms of research excellence and engineering to enable the industrial use of graphene in the future. Professor Hong has also established a spin-off company, Graphene Square Inc[31], which is the official graphene supplier to Samsung Electronics. He is on the Strategic Advisory Council for the EU's €1 billion Graphene Flagship Project[32], teaming up with the Noble Prize winners Andre Geim and Konstantin Novoselov (both at the University of Manchester).

The presentation from Professor Hong was well-received by the delegates who indicated that the research being undertaken by the Graphene Research Laboratory was world-class and of major significance to the future of 2D materials.

The reported applications of graphene for stem cell research,

wound healing and electron microscopy of biological objects are very exciting and along with other biosensor applications like cancer cell and biomarker detection, represent a research area in which the UK has established academic and industrial capabilities. Mission delegates felt that the UK's proficiency in the life sciences industry, and the extent of research based within the UK, could motivate Graphene Square Inc to expand beyond South Korea and seek assistance in achieving a breakthrough in the life sciences area where the quality of graphene is sufficient, and relatively-high manufacturing costs are less relevant.

The current manufacturing costs for CVD-grown graphene of US$40 per m^2 is about twice the current cost of Indium Tin Oxide (ITO). It is felt this increased cost is prohibiting greater usage, particularly in the encapsulation of organic light-emitting diodes (OLEDs). Professor Hong estimated that graphene costs would not be comparable with ITO until around 2024.

SNU and Graphene Square Inc are working with South Korean industrial partners on research and application development. Mission delegates felt that there might be an opportunity to develop and strengthen relations with SNU/Graphene Square Inc to facilitate the development of solutions for applications outside of their current commitments; notably in aerospace, wearable technology and bio-medical applications. Radio frequency (RF) and terahertz applications are other areas where UK expertise has the potential to encourage companies like Graphene Square Inc to invest within the UK and Europe.

In terms of other 2D materials like transition metal dichalcogenides (TMDS), Graphene Square Inc sell dedicated machines for metalorganic chemical vapour deposition (MOCVD). However, the results of these machines are still not good enough, in terms of achieved carrier mobility, to enter the market in micro- and optoelectronics in the short or medium term. Although significant progress has been made in CVD process development and the epitaxial growth of graphene, the carrier mobility required for flexible optoelectronics can't yet be obtained with this technique and is still significantly lower than can be achieved using exfoliated graphene.

The Expert Mission delegates felt that this is a good area of focus for R&D within materials departments of UK universities, and that funding should be committed to developing new and improved concepts for large-area thin-film deposition and device manufacturing, and to explore new applications.

[29] www.useoul.edu
[30] www.graphene.re.kr
[31] www.graphenesq.com
[32] http://graphene-flagship.eu/project/management/Pages/Strategic-Advisory-Board.aspx
[33] www.jj.ac.kr/eng

2.2.5 AMRC Asia

In December 2017, AMRC Asia was established as part of the University of Sheffield Advanced Manufacturing Research Centre (AMRC) Group. A Memorandum of Understanding by Sheffield University, The Korea Institute of Carbon technology (KCTECH), Jeonju University[33] and Jeonju City resulted in AMRC Asia being established to facilitate collaboration with Korean partners in the fields of:

- Government-backed R&D projects that focus on advanced manufacturing technologies.
- Technology development and consultancy for high-value manufacturing organisations.
- Industry training programmes in the field of advanced manufacturing technologies.
- Global networking between South Korean companies and industrial partners within the High Value Manufacturing Catapult network.

Significant investment has been committed to the construction of facilities in the Gyeongsan City area for the AMRC Asia project. In 2019 work will start on a Factory 2050 facility, similar in design to the UK site located in Sheffield, which will be fully operational within three years. The surrounding area is an established industrial centre with many organisations originating from there, including Samsung and LG Electronics. Several clusters including biotech, robotics, IT, additive manufacturing, automotive tier-two suppliers and construction suppliers are nearby. The region focuses on carbon, nano-materials, titanium, aluminium lightweight materials and green materials for automotive applications, batteries and power management. Gyeongsan City has the ambition to be South Korea's largest carbon composite production area with the creation of 20,000 jobs.

The establishment of AMRC Asia provides a significant opportunity to develop further programmes of collaboration between the UK and South Korea, particularly in advanced materials, with current focus on collaborative projects in the areas of composite manufacturing, additive manufacturing and Industry 4.0.

2.2.6 Korea Institute for Advancement of Technology

The Korea Institute for Advancement of Technology[34] (KIAT) is a quasi-government public institute under the Korean Ministry of Trade, Industry and Energy[35]. Of all of the South Korean funding agencies, it is the one that most closely resembles Innovate UK. KIAT distributed around US$1.2 billion in technology project grants and R&D funding in 2017. South Korea has been an associate member of the EUREKA[36] European collaborative R&D network since 2009. KIAT also co-funds bilateral R&D projects with the US, China, Germany, Czech Republic, Switzerland, the Netherlands, Canada and Israel, with a budget of US$45 million in 2016.

[33] www.jj.ac.kr/eng
[34] www.kiat.or.kr/site/engnew/index.jsp
[35] english.motie.go.kr/www/main.do
[36] www.eurekanetwork.org

3. Working with South Korea

3.1 South Korean Chaebols

A group of very large, mostly family-run business conglomerates, called chaebol, dominates South Korea's economy. Supported by the South Korean government since the early 1960s to be internationally-recognised brands, these powerful conglomerates played a central role in transforming what was once a humble agrarian market into one of the world's largest economies.

Although more than forty conglomerates fit the definition of a chaebol today, a handful have a significant impact on the South Korean economy. The top five: Samsung, Hyundai, SK Group, LG Corporation and Lotte, which collectively represent approximately half of the South Korean stock market's value and employ 10% of the national workforce.

Chaebols also drive the majority of South Korea's investment in research and development and have research centres or partnerships around the world. Domestically, chaebols hold the key control in innovation partnership, IP protection and technology commercialisation in working with South Korean SMEs, research organisations or universities.

Working with chaebols demands significant commitment including a local presence available to meet face-to-face, provide resources and rapid response. UK organisations may struggle to satisfy the demands put on them from such relationships, especially with added language, time and cultural differences. SMEs, in particular, may find this challenging, although large enterprises with sufficient resources and support may be in a better position to develop collaborative opportunities with chaebols.

3.2 Clear Desire to Collaborate

The UK and South Korea first signed a Science and Technology Cooperation Agreement in 1985 and have enjoyed a collaborative relationship since. The UK Science and Innovation Network (SIN) in South Korea continues to undertake a biennial review of cooperation activities between the two countries and works with the Korean Ministry of Science ICT and Future Planning (MSIP), Ministry of Trade, Industry and Energy (MOTIE) and Ministry of Health and Welfare (MOHW) to agree on areas of collaboration.

Programmes of collaboration for joint research in fuel cell technology, nuclear decommissioning and radioactive waste management, advanced materials, energy storage and smart grid technology are amongst those that are already underway or in the latter stages of agreement.

South Korean businesses have access to finance, as determined by the strategies set out in the Fourth Basic Plan. They can undertake collaborative programmes much more readily than other nations and, as such, present an opportunity for UK businesses to partner on collaborative ventures.

It was noted, during the Expert Mission that organisations are open to the idea of collaborating with the UK. Discussions held with KIST, KIAT, local government representatives for Gyeongsan City and Seoul National University all indicate a willingness to develop collaborative activity on advanced materials. An example of successful collaboration is the creation of AMRC Asia.

However, important historical and cultural ties between South Korea and Germany may pre-dispose South Koreans to consider Germany as an initial point of contact for collaboration. USA, Germany or China would currently be considered as a partner for collaboration before the UK. Spain is also seeking to develop greater collaboration.

3.3 Opportunities to Collaborate

South Korea is highly regarded for developing innovation and manufacturing capabilities. They have committed significant public spending to the achievement of a series of strategic Basic Plans and have developed an R&D infrastructure that has a strong focus and cohesion.

The strategy of growing exports by increasing internal capacity has been replaced by one that is seeking to grow through innovation. South Korea exhibits significant expertise in applied research, but their basic research capabilities are weak requiring them to "buy in" the fundamental knowledge that can then be applied to achieve their innovation goals.

It was expressed, on several occasions, during the Expert Mission that there was a desire to collaborate with the UK. Delegates felt that while there are undoubtedly opportunities for R&D collaboration, South Korea's imperative is the need to achieve the stated goals of the Fourth Basic Plan for the benefit of the country. Chaebols, which are the engine behind the South Korean economy, have a long history of acquiring knowledge and keeping benefits within their organisations.

There was a strong bilateral interest during the Expert Mission to increase knowledge sharing opportunities. Among the suggestions made was the development of an industry group made up of SMEs, academia and large enterprises to share information and opportunities, and to develop common standards and specifications. The need to have international standards for product manufacturing and performance recognised by customers and producers was of concern. In the short term, increased networking via workshops, conferences and bilateral academic exchanges were also considered to be an opportunity for collaboration.

Joint R&D is an area where there is significant potential for collaboration. The UK's strong advanced materials research base and experienced technology transfer capabilities coupled with South Korea's expertise in applied research could help identify technology and business opportunities. The work already commenced with AMRC Asia and South Korean partners is a potential starting point to increase R&D collaboration.

The development of solutions for applications in aerospace, wearable technology, biomedical applications, RF and terahertz could result in significant R&D outcomes with global importance. The delegates felt strongly that this was a significant opportunity that should not be ignored.

Annex 1
List of UK Participants

British Embassy, Science and Innovation Network team	
Cambridge Nanomaterials Technology Ltd	www.cnt-ltd.co.uk
Imperial College London	www.imperial.ac.uk
Innovate UK	
Knowledge Transfer Network (KTN)	
Lucideon	www.lucideon.com
National Composites Centre (UK Catapult)	www.nccuk.com
NSG Pilkington Global	www.nsg.com
Smart Separations	www.smartseparations.com
The Welding Institute (TWI)	www.theweldinginstitute.com

List of South Korean Participants

Ajin Industrial Co Ltd	www.wamc.co.kr
AMRC Asia	
Dyetec	www.dyetec.or.kr
Graphene Square Inc	
Gyeongbuk IT Convergence Industry & technology Centre (GITC)	www.etri.re.kr
Gyeongsan City Mayor's department	
Hanwha Advanced Materials	
Hyundai Motor Group	
Intralink	www.intralinkgroup.com
Korea Institute of Advanced Composite Materials	jb.kist.re.kr
Korea Institute for Advancement of Technology (KIAT)	
Korea Institute of Science and Technology (KIST)	
Large Co Ltd	lgind.com
Seoul National University (SNU)	
Shin Young Co Ltd	www.shym.co.kr
Standard Graphene	standardgraphene.com
T4L (Textile for Life Co Ltd)	www.t4l.co.kr
Taesung CND Co Ltd	www.tscnd.kr
Toray Advanced Materials Korea Inc	www.torayamk.com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