Fusion Business
tomorrow's technology for today

UKAEA Fusion Working in Europe

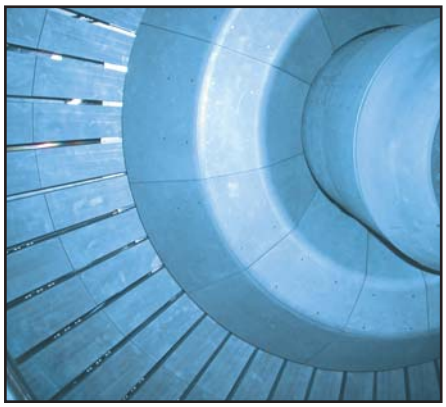
Culham Science Centre

www.fusion.org.uk/industry

Issue 28 August 2004

Morganite Specialty Graphite supplies tiles for MAST divertor

Morganite Specialty Graphite (MSG) has recently machined and delivered new graphite tiles for the new improved divertor on the Mega Amp Spherical Tokamak (MAST) at the Culham Science Centre.



The South Wales based company was asked to machine large blocks of fine grain, isostatic pressed graphite, supplied by UKAEA, into 300 graphite tiles arranged into a fan shaped ring divertor at the top and bottom of the MAST machine, as shown in photo above.

Divertors are the part of tokamak fusion experiments where the plasma touches material surfaces. Although the temperature in the core of the MAST plasma is around 30 million ^{0}C, at the edges it is much cooler, less than 3,500 ^{0}C - the upper temperature limit for the graphite tiles.

"The biggest challenge we faced was programming the CNC vertical milling cutting machine to maximise the number of tiles per block and avoid waste," commented Steve Schomberg, Customer Service Manager, Morganite Specialty Graphite. It took the company 450 hours of machine time followed by co-ordinate measurement machine inspection to produce the tiles.

Part of the new MAST graphite divertor.

"We've worked with MSG before on the graphite tiles for the MAST centre column so we were confident of their ability to machine the tiles," said Andrew Darke, Project Manager for the MAST divertor upgrade. "Indeed the centre column tiles that MSG made for us previously were a good deal more complicated than the new divertor tiles. The centre column tiles are castellated and joined to form a ring around the column, each tile includes interlocking pin holes to lock the tile into place."

"The biggest challenge we faced was programming the CNC vertical milling cutting machine to maximise the number of tiles per block and avoid waste."

Morgan Specialty Graphite is a global business within Morgan Crucible plc located in over 20 countries. MSG represents a new generation of engineering company. Their mission statement states "Our global customers challenge us with complex engineering problems – high temperature, corrosion, mechanical wear, maybe all three. Our mission is to engineer new and exciting possibilities for our customers, partnering them as they shape technology and the future...." MSG markets include energy, communications, aerospace, thermal management, metallurgy and environment.

This newsletter is produced by the UKAEA Fusion & Industry Team based at Culham Science Centre. For further information please contact: Deniese Willis, Fusion & Industry Events Manager: deniese.willis@ukaea.org.uk

Inside This Issue:

KNOWLEDGE TRANSFER PARTNERSHIP

The Knowledge Transfer Partnership – Could it benefit your business?

Fusion & Industry is evaluating the benefits of taking part in the Knowledge Transfer Partnership (KTP) scheme and invites companies interested in participating in KTP to contact them.

What is KTP?

Knowledge Transfer Partnership is a DTI-assisted scheme designed to bring companies and public sector research organisations together, with the objective of improving the competitiveness of companies. In essence it allows SMEs and larger organisations to undertake product and service developments where they may lack the resource and technical expertise necessary. "In the case of suppliers to fusion research this may involve developing new technology to meet the demands of say ITER and IFMIF," explains Dan Mistry, Fusion and Industry Manager.

KTP is an opportunity for companies to work with leading experts in plasma physics, computer modelling and other fusion related technologies in new product developments, but it doesn't have to stop there. "Project management and meeting quality standards are as important as the technology, here KTP can be used to put in place business processes to deliver improvements," said Dan.

Knowledge Transfer Partnership is one of the DTI's most successful initiatives for assisting companies. Formerly known as the Teaching Company Scheme, it has been running for a number of years and during this time has been shown to contribute to the overall increase in the value of participating companies, and increases in sales and profitability.

Details of KTP can be found at www.ktponline.org.

Companies interested in participating in KTP with UKAEA as the technology partner should contact Miriam Mason on miriam.mason@ukaea.org.uk.

Collaboration develops new laser diagnostic for MAST

More than ever fusion research is focussed on understanding the internal dynamics of the plasma. An important technique for doing this is to use laser diagnostics to collect data on the plasma's temperature and density. One aspect of the recent MAST upgrade has been the deployment of a laser diagnostic system developed over the past two years which we first reported in Fusion Business. This system will allow researchers to study the complete evolution of the plasma discharge in far greater detail.

Roger O'Gorman from UCC setting up a fast switching crystal for use within the system.

This has been achieved by a collaboration between UKAEA and Walsh Scientific with the Electrical Engineering department at University College Cork (UCC), Ireland who have been working on the beam combining system. The technique allows multiple lasers to be combined to illuminate a single sampling line inside a hot plasma and provides very high repetition sampling of the spatial variation of the electron velocity distributions. Presently it is used to combine pairs of lasers.

Michael Walsh from Walsh Scientific explains, "MAST has two pairs of lasers combined in this way each running at 100Hz giving a record for the field of 200 pulses per second continuously and producing powers of over 150 Megawatts/pulse. Flexibility to study very fast relaxation events across the measuring path by bunching lasers is inherent. The technique is modular and could be extended to other laser systems with relative ease."

For more information contact: info@walshscientific.com

People Spin Off

Profiling people who started their careers in fusion and are now using the skills they developed in other areas

Part Nine — Peter Kind

After completing his degree in Chemical Engineering at Cambridge, Peter joined the National Coal Board. In 1969, he began his long association with UKAEA, initially as a consultant to AERE Harwell assessing the market potential of spin off products. He joined the UKAEA in 1975 and until 1979 supported the Chief Scientist at the Department of Energy, Walter Marshall, before being seconded to the Cabinet Office. In 1982, he returned to the UKAEA and was appointed Project Control Officer for JET at Culham. In 1987, he left for the European Commission, where he worked in Research Directorates on Fusion, Training & Mobility, and Health. From 2001 to 2003, he was Director responsible for structuring the European Research Area and in 2004 was appointed to his current post as Director of the Institute for Prospective Technological Studies in Seville.

Working at JET brought Peter Kind in touch with Brussels and combined with his previous experience of government policy work enabled him to move effectively into that milieu.

He told Fusion Business, "Fusion research is one example of a category of research that can only be done by governments and one of only a few ways of ensuring long term energy supplies in the future. Although no amount of spin off could of itself justify such a programme, when people of high calibre were brought into such a project it is inevitable that many new ideas and new sets of skills would be generated. I attach particular value to the "intensely" multi disciplinary nature of fusion research and also the great level of international collaboration involved."

UKAEA trials Photonic Cleaning system in JET

Scientists at Culham are reporting success in using intense light flashes to clean the tiles in the divertor region of JET. This 'photonic-cleaning' technique involves placing a special flash-lamp and optics system at the end of a robotic arm and manipulating it within the JET torus from a remote control room.

Photonic cleaning in progress in the JET vessel.

The use of intense radiation in the visible and UV, from flash-lamps and lasers, for low impact cleaning of surfaces is a well developed technology in the micro-chip and aerospace industries and for art restoration, but is new to Fusion. Photonic-cleaning offers a possible alternative to oxidisation for the removal of tritiated hydro-carbon films during planned maintenance breaks.

Recently engineering trials of a photonic cleaning system, developed by UKAEA with the UMIST and Liverpool Universities under a European Fusion Development Agreement Task, have been conducted in the JET vessel under full remote handling conditions. The system uses a xenon flash-lamp providing a staggering 3 million watts of light output which, when focussed onto the surface to be cleaned, delivers around 2 billion watts per square metre. The surface is instantly heated by over 1,000 degrees completely evaporating surface layers - such as the co-deposited film. The pulse, however, is so short - around 1/10,000th of a second - that the underlying material - be it the expensive divertor tiles or, in other applications, a delicate micro-chip or a treasured work of art - is untouched.

Dr Glenn Counsell, who is in charge of the project at UKAEA said, "We are enormously pleased. These trials have clearly demonstrated that photonic cleaning is a strong candidate for clean, non-destructive removal of surface contamination in future fusion devices. The success of employing this technique in such a new environment suggests to me that photonic cleaning may also be a powerful tool for many other industrial applications".

ITER update

The ITER website, www.iter.org has posted the following message on its homepage with regard to the siting issue: "Delegations from China, European Union, Japan, the Republic of Korea, the Russian Federation, and the United States met at the IAEA headquarters in Vienna on 18th June 2004 to advance the ITER negotiations.

The two potential Host Parties, European Union and Japan, presented their positions, taking account of recent bilateral discussions on a broader approach to realising fusion energy. The parties noted that the contents of these offers were essentially symmetrical and showed a readiness of each of the potential Host Parties to contribute significantly to the realisation of elements of the Broader Approach other than ITER in addition to their contributions to ITER itself.

All Parties stressed the urgency of reaching a rapid resolution of the siting issue so as to move forward to implementation of ITER in a framework of international collaboration."

Celebrating JET's 25th Anniversary

On 20th May VIPs including Philippe Busquin, European Commissioner for Research, key players in the international fusion scene and ex-JET staff gathered at Culham Science Centre to celebrate the 25th anniversary of the laying of JET's foundation stone and the 20th anniversary of its official opening by Her Majesty Queen Elizabeth II.

Sir Chris Llewellyn Smith, Director of the UK's national fusion research programme read out a message from Prime Minister Tony Blair congratulating everyone involved with JET's achievements. "I take very seriously the problems of climate change and security of energy supply… fusion is one of the most promising technologies that could help solve these problems. The Government's Chief Scientific Advisor, David King, and I are both convinced that ITER, the next step in fusion, is an essential international endeavour and we hope to see the siting issue resolved in the next few months."

Update – Fusion & Industry Website

The Fusion and Industry website is currently being completely re-designed and further developed to give it a "new look" to make it even more user friendly - more news in the November issue of Fusion Business.

Culham Innovation Centre

UKAEA's Technical Support Package Assisting Start-up Companies at Culham

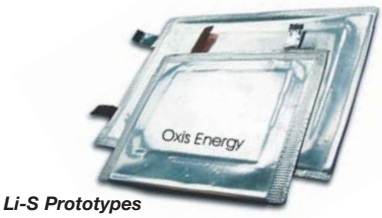
For an increasing number of start-up companies in the Culham Innovation Centre the UKAEA's Technical Support Package (TSP) is playing an important role in their success.

The Technical Support Package has a proven track record of assisting start-up companies at the centre with product development and problem solving with the assistance of UKAEA's Special Techniques Group. Characterised by its flexible access to fusion-related technologies and skills, the technical support is used by a wide cross section of start-up companies. Four companies are currently using the TSP to support their business growth.

Intellikraft – using TSP to investigate lithium-sulphur batteries

Specialists in rechargeable batteries design and development, Intellikraft has recently increased its office space at the Centre to build a fully equipped laboratory for a collaborative project with the University of Cambridge to investigate a new type of rechargeable battery technology based on Lithium-Sulphur (Li-S) electrochemistry.

Li-S batteries currently offer similar performance to lithium-ion (Li-Ion) batteries but they are lighter and can be safer both in operation and environmentally. According to Intellikraft Managing Director Gleb Ivanov, Li-S has been overlooked by many companies as being too technically demanding. However, the growth of mobile electronic devices such as smart cards and laptop computers, and weight critical applications such as hybrid cars, has created a market for lighter alternatives to existing battery technology. Gleb and his team are using the TSP to assist in the development of bespoke test equipment. "We give the drawings to the UKAEA's Special Techniques Group and they are able to build the equipment in a couple of days, enabling us to quickly move on to the next stage of development," said Gleb Ivanov.



Li-S Prototypes

Laplacian – using TSP for engineering assistance to study concrete degradation caused by water movement

Meanwhile at Laplacian, Peter Aptaker is collaborating with the University of Surrey on an innovative application of Magnetic Resonance Imaging (MRI). The project concerns applying MRI techniques to study concrete degradation caused by water movement in built concrete structures. The cost to UK plc of degradation of buildings resulting from water transport is enormous; it is estimated that £550 M is spent on bridge repair a year alone. However despite the size of the problem, the civil engineering community still lacks adequate means of accurately measuring and characterising water in concrete.

Laplacian's contribution to the project is the development of a proof of concept portable sensor. Here the company has drawn on its TSP for precision engineering assistance in forming protective metal plates round the sensor and bending copper wire for the magnet windings.

"Vacuum brazing has allowed us to make a robust portable case for the MRI sensor; the next stage is to see how it performs in field trials over the next 12 months. The sensor will monitor moisture 50mm within the concrete construction to provide a profile of the underlying pore structure and pore water content," explained Peter Aptaker, Managing Director, Laplacian.


Dee Bridge tower elevation

Oxford Scientific – using TSP to look at advanced bonding techniques

When the Culham Innovation Centre opened in 2001, one of the first companies to take advantage of the TSP was Oxford Scientific. Three years on the company's business in microwave plasma sources has grown significantly. Founder and Managing Director Christian Bradley believes the combination of integrated hardware and electronics design is such that the instruments deliver the right levels of functionality yet avoids complexity.

Reliability and quality are important considerations when you realise that all Oxford Scientific's business is overseas at research and academic institutions in Europe, USA, Korea, Taiwan and the South East Asia.


One of Oxford Scientific's ion sources.

"The TSP is very useful in both product development and overcoming technical problems. It was also important in enabling us to complete a SMART award. We are currently using the TSP to look at advanced bonding techniques for titanium and aluminium," says Christian Bradley.

Reaction Engines – using TSP to develop compact heat technology


Skylon re-entry

Another early user of the TSP was heat exchanger innovator, Reaction Engines Ltd. The company specialises in developing compact heat exchanger technology that will eventually be used in space planes and high speed commercial airliners.

In addition to high speed cameras and assistance in setting up a wind tunnel, the TSP has provided Reaction Engines with access to precision engineering expertise used in completing a SMART award. Recently the company was given a second SMART award worth £142,000 to build a heat exchanger prototype production unit. The unit will undergo trials in a test facility being built on the Culham site using a Viper gas turbine jet engine early in 2005. "The TSP has been very useful, it is convenient and allows doorstep access to the expertise of UKAEA's Special Techniques Group with minimum bureaucracy," says Managing Director Alan Bond.

'Fusion Business' is produced by WORDSMITH at the Winfrith Technology Centre Tel: 01929 463178 E-mail: gill.wordsmith@ntlworld.com