



The Institute of Materials, Minerals & Mining

MATERIALS SCIENCE AND TECHNOLOGY DIVISION ANNUAL REPORT, DECEMBER 2011

1. Board membership

The technical committees comprising the Division in 2011 were as follows:

HTMC: High Temperature Materials Committee. (Chair: Gordon McColvin)

MCC: Materials Chemistry Committee. (Chair: Andrew Watson)

NNC: Nanomaterials and Nanotechnology Committee. (Chair: Martin Kemp)

PEC: Particulate Engineering Committee. (Chair: John Dunkley)

RC: Rolling Committee. (Chair: Mick Steeper)

SMASC: Smart Materials and Systems Committee. (Chair: Markys Cain)

SPMC: Structure and Properties of Materials Committee. (Chair: Brad Wynne)

SPC: Superplasticity Committee. (Chair: Rajab Said)

FMC: Functional Materials Committee. (Chair: Mike Reece)

DSSMC: Defence, Safety and Security Materials Committee. (Chair: Eoin O'Keefe)

The current MSTD Board comprises the Chairs of the technical committees, the Chairs of the Surface Engineering and Light Metals Divisions, the Chair of the Incorporated Engineers and Technicians Committee (IETC), the vice-chair of the Sustainable Development Group and a representative from EPSRC

The Chair of the MSTDB stands down at the end of 2011; Dr Mike Winstone will succeed him.

During 2012 it is intended that a new IOM3 Division, the Functional Materials Division, will be formed. SMASC, NNC and FMC will move to this Division

Thanks are expressed to all those who have served on the MSTDB during this year.

2. Board meetings

Board meetings were held in January and July, both being well attended, and there have been approximately 25 meetings of the constituent committees. Typical attendance at committee meetings is 50% of nominal membership.

3. Opportunities for growth of Division Communities or constraints.

The on-going strategy of the MSTD is to work with the funded networks, particularly the KTNs, either jointly organising or co-sponsoring meetings, even though this means that the number of specifically Institute events may continue to drop. The web-site provides each of the committees with the opportunity of a micro-site of the same functionality as the divisional micro-sites. It is

hoped that, in due course, the potential of the web-sites will be fully exploited by the MSTD committees.

There are indications that Government has more recently identified the importance of materials to the nation's wealth creation and a recent TSB funded competition has identified Advanced Materials as a specific area they wish to fund.

Committee specific developments are outlined below:

DSSC: Changes in Government spending have had an adverse effect over the past year on the majority of organisations represented by the committee. However, there has been an increase in headline budget for the MoD's underpinning materials and structures research programme. The focus on threats to the Nation arising from 'cyber criminality' and 'cyber military operations' has reduced the importance of more traditional physical security systems, where materials play a larger role. Security of supply of materials is widely discussed in the popular and technical press and is an area of particular interest to the Military supply chain where many of the more exotic materials find application in critical systems. There has been a marked increase in market price of a number of metals, this has led to an increase in their theft from the National infrastructure; copper cables running beside train tracks being one target that gets significant coverage in the press.

FMC: The FMC strategy is to hold hands-on workshops in materials processing for early stage researchers, engaging with centres of expertise in the relevant areas, such as Doctoral Training Centres. The aim is to hold four events per year related to functional/electronic materials, which is considered appropriate to the title of the committee, its size and the expertise of the committee members. When the committee moves to the new Functional Materials Division the name of the committee will change to the Functional Materials Training Board, reflecting its focus on training in materials processing. This may provide the opportunity to widen the area of activity to include other areas of materials processing by working with the other committees in the new Division.

MCC: The strategy document for Phase Diagrams and Thermodynamics is complete and ready for publication. It is planned to 'launch' the document during Materials Congress during the Fringe session on 'Phase Diagrams and Sustainability.' The Committee is looking 'healthier' than it has for quite some time, although the aim is to increase its size further by searching for members from industry.

NNC: Activities have reduced over the past two years and the biennial conference did not take place in 2010 due to various factors. All of which has meant that the new Chair has had to build up the Committee membership and activities from scratch. Progress is now being made in developing an active programme for 2012. One aspect is to focus on raising awareness of nanotechnology to non-specialist audiences, for example through evening talks. The Committee has also approved setting up a strategic link with NanoKTN and the annual event 'High Performance Nanomaterials' – HiPerNano. This will provide gearing for the NNC effort and an opportunity to lead or contribute to technical steering groups for various seminars.

PEC: The shrinkage of the classical PM sintered parts business in the UK has not reversed. Building on the decision last year that the future role lies in collaborating with other committees whose more specific areas are impacted by particulate engineering, a very successful meeting was run on November 16th on HIP working closely with the High Temperature Materials Committee and the EPMA. Discussions held within the context of the PEC meetings including the one with

Powders Advisory Board, highlighted the suitability of an improved position for PEC in the strategic discussions related to Particulate Engineering and Powders sector in the UK and associated initiatives such as TSB programmes, calls for proposals for encouraging R&D in the country etc. The well balanced mix of academic and industrial members of PEC also places the committee favourably to interact with a larger community in exploring pool of opportunities for collaboration and raising awareness of the potential of particulate engineering across wider Europe.

RC: The Committee remains concerned about the relatively depressed state of the steel and non-ferrous rolling industry, and the impact this has on support for conferences.

There is no expectation of a change in outlook during 2012. The long-term usefulness of the Committee needs to be addressed in the light of this, and proposals for expanding its scope to include forging and other solid-phase metal forming processes (which were rejected by the Committee in 2010) will be re-drawn and re-presented in 2012.

SMASC: The committee has strived to maintain a good balance of industrial and academic membership and to ensure that a broad range of expertise is represented. One area of expertise that the members believe should be represented on the committee is molecular modeling; a known expert in this field has been approached, who was able to suggest possible contacts that can be followed up. The current strategy of building stronger links with other networks through hosting / supporting joint events and to hold evening seminars has worked well and will be continued for the foreseeable future.

SPC: After several months of discussion amongst committee's members, and consultation with other committees in IOM3 to ensure there is no source of a conflict, the committee has agreed to widen its scope and domain of interest. Main motivation behind this initiative is that the majority of committee members work across the sheet metal forming field rather than just Superplastic Forming (e.g. Hotforming, Hydroforming, Stretchforming, Creep Age Forming, etc). Also, in addition to the interest in the forming process itself and associated technology, there is a strong interest in a wider selection of alloys and its behaviour outside the superplasticity zone in general. The committee, at its last meeting on 21st Sept, has agreed to expand its merit to cover the field of sheet metal forming in general. The proposed name is Advanced Sheet Metal Forming. A new mission statement and terms of reference will be formulated in early 2012. With the expansion in domain of interest a number of new members will be formally invited to join the committee next year. The current list of potential members includes: Ulster University, Novelis, Timet, Elektron-Magnesium, Southampton University and Innoval Technology.

4 Technical programme

The year has seen an improvement on the previous year's technical programme although the economic situation continues to constrain attendance. Highlights for the year included:

- **DSSC's** first conference 'Advances in Helmet Technology' at 1 CHT on 10th February 2011. The conference was supported by United States Army International Technology Centre Atlantic (USAITCA), the Materials KTN and IMechE. In support of the conference the Materials KTN also sponsored a Student Design Competition.
- **DSSC** ran an online photographic competition on the theme of 'Materials in Defence'. 63 entries were received and prizes will be awarded at a suitable event in Early 2012.
- "Ceramic Processing" Workshop, the Centre for Advanced Structural Ceramics, ICL, 21-23 Sept, 2011. **(FMC)**.

- The 8th International Charles Parsons Turbine Conference, 5th – 8th September 2011, the University of Portsmouth, **(HTMC)**.
- “HIP processing of materials for aggressive environments”, 16th November 2011, Derby, **(PEC and HTMC)**.
- “21st Century Rail”, 1st-3rd November 2011 at the National Railway Museum, York. **(RC)**
- “Nanorectification”, London (1CHT), 5th May 2011. **(SMASC)**
- “Euro SPF 2011”, 21st September 2011, University of Strathclyde **(SPC)**. Organised in collaboration with the European SPF Committee.

5 Technology Foresight Developments.

The MCC, with input from the SPMC, has completed the final draft of a strategy document concerning the low current state of Materials Chemistry research and teaching in the UK, specifically from the point of view of thermodynamics. This will be launched in 2012 and is targeted at stake holders in the sector with a view to identifying a programme of action to address the situation.

6 Professional membership developments

Most, but not all, committee members are Institute members at various levels except where they have been invited as representatives of other organisations. Non-members are being encouraged to join the Institute as part of the membership drive. Members are also being encouraged to apply for Fellowship where appropriate and a number have been admitted as Fellows in the past year.

Many committee members are engaged individually with their local societies but more interaction between committees and local societies would be beneficial. MSTDB Committees continue to offer speakers to local societies.

7 National and international linkages with other Societies /Institutes

A major part of MSTDB strategy is to strengthen co-operation between its constituent committees and with other technical communities within IOM3. In addition the committees of the Division continue to benefit from strong national and international links, examples include:

- The MSTDB chair represents IOM3 on the IMechE Structural Technology and Materials Group.
- SPC has a very strong association with the French Superplasticity Group with whom it organises the Euro SPF series of meetings.
- The Materials Chemistry Committee provides the UK representative on the Alloy Phase Diagram International Commission (APDIC).
- HTMC has links with TMS. Efforts are in progress to reinstate the link with NAMTEC.
- The chair of the Mats UK Energy Materials Working Group is a member of the HTMC; other members also participate.
- The Rolling Committee maintains strong links with the Rolling Guild with several members of the committee being active members of that group. A modelling event is in planning with FFA.
- SMASC contributes several members to the board of the Smart Materials sector of the Materials KTN.
- SPC is recognised as a BSI committee for superplastic forming.

- The chair of the RSC Chemical Nanosciences and Nanotechnology Interest Group, represents the RSC on the NNC.
- SMASC has links through its chair with the Piezo Institute and the IOP Dielectrics Committee. SMASC has also worked closely with the Smart Materials Sector of the Materials KTN and also the MBE to host events in 2011.
- The chair of the Advisory Board for the ICSAM Conferences is a member of the SPC.
- The FMC has links with the UKCME, a DTC (Polymer Electronics ICL-QMUL) and CASC.
- An active link is maintained between the PEC and the European PM Association (EPMA). Two PEC members are participants in a major collaborative project called Dira-Green on digital radiography of PM parts, funded by FP7 bringing together several PM organisations and societies including the Turkish Powder Metallurgy Association (TPMA) TPMA..

8 Government interfaces

- The Divisional board and most of the technical committees have representatives from EPSRC.
- The Chair of the NNC is Engineering Applications Theme Manager for the NanoKTN.
- A member of the Division is a manager at the Technology Strategy Board.
- The chair of the Advanced Power Generation Task Force Materials Sub Group and the Mats UK Energy Materials Working Group is a member of the HTMC.
- The Thermodynamics and Phase Equilibria work of the MCC is regarded by NPL as an integral part of the National Measurement System. It is intended that the MCC Strategy Document for Phase Diagrams and Thermodynamics will initiate a discussion into the future of the field from a teaching/research/funding perspective.
- The PEC collaborates with the Powder Metallurgy sector of the Materials KTN.
- SMASC collaborates with the Smart Materials sector of the Materials KTN.
- The work of the DSSC is intimately involved with the Government's work. This alignment is reflected in the make-up of the committee membership. The committee prepared and submitted a consultation response to the Government Green paper 'Equipment, Support, and Technology for UK Defence and Security
- SPC has links with the The Advanced Forming Research Centre (AFRC), which itself has direct links with Scottish Enterprise and TSB. BAe Systems and Rolls Royce are making good progress in two separate R&D Projects under the umbrella of SAMULET project. All academic partners work closely with EPSRC and some with TSB.

Industry / Academia programmes, such as LINK and the KTNs, provide potential sources of income for collaborative projects. A number of committees and individual members are involved in such projects and it is felt that there is further scope for this, particularly through the KTNs.

9 Institute Publications

a. Web-site

The basic committee microsites are reviewed and updated on a regular basis; technical content is added with varying degrees of enthusiasm.

The MCC microsite annex, created as an open access resource for teaching and research materials related to phase diagrams and thermodynamics, continues to be expanded.

The NNC microsite has been reviewed with an amended vision statement and an overview of nanotechnology added. Further information on selected applications for nanotechnology has been identified and appropriate topics are being assessed for modification for inclusion on the website.

b. Materials World

Last Line of Defence, 19(4), 27-28. Ian Horsfall and Debra Carr.

The Hard Headed Approach, 19(4), 9. Eoin Redahan.

Striking out with Materials R&D, 19(4), 34-35, Dan Kells and Dan Jones

Lightening the load, 19(10), 18-19, Charlotte Meeks and Andy Foreman.

Putting Theory into Practice, 19(11), 22-24, John Gisby and Alan Dinsdale

c. Other publications

“Sustainable Materials: With Both Eyes Open”, by Julian Allwood (RC).

“Superplastic Forming and Diffusion Bonding of Titanium Alloys”, by Norman Ridley (SPC). Published by John Wiley & Sons

The Powder Metallurgy Journal receives active support from the PEC as editorial board members and reviewers. This is considered highly important for further increasing the impact of the journal as an ideal medium for dissemination of research and technological developments alongside market reviews, which would be perceived as a valuable source of information for the particulate engineering community in general. At the moment, International Journal of Powder Metallurgy (IJPM) by APMI from the US is doing rather well in that regard, when it comes to capturing market status and facts which are of significant interest to industrialists. PEC is therefore keen to focus on this aspect for potential improvements.

10 Awards/Prizes

- The Kroll Medal and Prize, in recognition of a significant contribution that has enhanced the scientific understanding of materials chemistry as applied to the industrial production of materials, normally inorganic, was awarded to Professor Serena Best (Cambridge University).
- The Hume-Rothery Prize, in recognition of distinguished achievements concerned with phase relationship in metallic materials or non-metallic materials of metallurgical interest, was awarded to Professor F P Glasser (University of Aberdeen).
- The Dowding Medal and Prize in recognition of a major contribution to the invention, development or design of metallurgical plant, particularly rolling and finishing, leading to improved economy, yield or quality in metal production was awarded to Dr Hugo Uijtendbroeks (ArcelorMittal Research)
- The Rosenhain Medal and Prize in recognition of distinguished achievement in any branch of materials science was awarded to Dr Mary Ryan (Imperial College, London).

- The Ivor Jenkins Medal in recognition of significant contribution which has enhanced the scientific, industrial or technological understanding of materials processing or component production using particulate materials was awarded to Dr John Liddle.

David Gooch, MSTDB Chair