

13th International Workshop on Plasma-facing Materials and Components for Fusion Applications / 1st International Conference on Fusion Energy Materials Science

Foreword

The 13th International Workshop on Plasma-Facing Materials and Components (PFMC-13) jointly organised with the 1st International Conference on Fusion Energy Materials Science (FEMaS-1) was held in Rosenheim (Germany) from May 9 till 13 2011. PFMC-13 is a successor of the International Workshop on Carbon Materials for Fusion Applications series. Between 1985 and 2003 ten “Carbon Workshops” were organised in Jülich, Stockholm and Hohenkammer. Then it was time for a change and redefinition of the scope of the symposium to reflect the new requirements of ITER and the ongoing evolution in the field. Under the new name (PFMC-11), the workshop was first organised in 2006 in Greifswald (Germany) and PFMC-12 took place in Jülich in 2009. Initially starting in 1985 with about 40 participants as a 1.5 day workshop the event has continuously grown to about 220 participants at PFMC-12. Due to the joint organisation with FEMaS-1 PFMC-13 set a new record with more than 280 participants.

The European project Fusion Energy Materials Science – FEMaS, coordinated by IPP, organizes and stimulates cooperative research activities which involve large-scale research facilities as well as other top-level materials characterization laboratories. Five different fields are addressed: Benchmarking experiments for radiation damage modelling, the application of micro-mechanical characterization methods, synchrotron and neutron radiation-based techniques and advanced nanoscopic analysis based on transmission electron microscopy. All these fields need to be exploited stronger by the fusion materials community for timely materials solutions for a DEMO reactor. In order to integrate these materials research fields, FEMaS acted as a co-organizer for the 2011 workshop and successfully integrated a number of participants from research labs and universities into the PFMC community.

Plasma-facing materials experience particularly hostile conditions as they are subjected to extremely high heat loads and very high particle and neutron fluxes. Plasma-facing materials must have high thermal conductivity for efficient heat transport, high cohesive energy for low erosion by particle bombardment and low atomic number to minimize plasma cooling. These contradictory requirements make the development of plasma-facing materials one of the greatest challenges ever faced by materials scientists. The erosion of plasma-facing materials is one of the main factors influencing the operational schedule of experimental fusion reactors and future power plants. A number of materials selected for current designs cannot withstand the presently foreseen plasma scenarios of a power plant for a commercially viable period of time. Therefore, further coordinated development of plasma scenarios and materials is essential for the realization of fusion as an energy source. The design and development of plasma-facing materials requires a detailed understanding of the processes that occur when a material surface is bombarded with an intense flux of heat, particles and neutrons simultaneously. These materials related topics are in the focus of this series of workshops which has established itself as a discussion forum for experts from research institutions and industry dealing with materials for plasma-facing components in present and future thermonuclear fusion devices.

During the joint conference PFMC-13/FEMaS-1 recent developments and research results in the following fields were addressed:

- carbon, beryllium, and tungsten based materials
- mixed materials
- erosion and redeposition
- high heat flux component development
- benchmarking of radiation damage modelling
- synchrotron and neutron based characterization techniques
- application of advanced TEM and micro-/nano-mechanical testing

With the approaching technical realization of ITER the ITER-related PFMC topics are naturally in the focus of research. In this respect the start of the ITER-like wall experiment at JET is of paramount importance for our community and several presentations were devoted to this topic. The start of the experimental campaign shortly after PFMC-13/FEMaS-1 will most probably bring about many exciting new results and leaves us eagerly waiting for the next PFMC conference. Several other topics which are of significant relevance for the preparation of ITER were addressed. Among them were dust detection and analysis which is a safety concern and the behaviour of beryllium. Due to the toxicity of beryllium dust great care has to be taken for the handling of beryllium-containing samples and as a consequence only a very limited number of places is worldwide available where such samples can be prepared and investigated. For a solid data base and a sound understanding of beryllium and beryllium-containing mixed materials much more efforts are necessary in the near future.

Naturally, traditional PFMC topics such as first-wall lifetime, testing and characterisation of plasma-facing components and hydrogen inventory had their appropriate share of the programme. Not to forget carbon, the nucleating material for this workshop series. Although it will, according to present planning, play only a minor role towards the realization of a DEMO reactor, it is still of importance for current machines and was covered in a large number of poster contributions.

Topics receiving continuously increasing attention are those related to devices beyond ITER. Such topics are development of advanced materials, their behaviour under high heat loads and in particular the consequences of neutron damage. The issue which was treated in quite a number of contributions was the simulation of neutron damage by implantation of heavy ions and its influence on hydrogen retention. This is presumably a topic which will receive continuous attention in the years to come.

As a consequence of the joint organisation with the FEMaS project several presentations addressed advanced characterisation techniques. Very remarkable examples of 3D tomography images of plasma-facing components using X-ray- or neutron-based techniques were shown. Such methods allow non-destructive and element-resolved analyses of buried interfaces and are therefore a very promising tool for future investigations of plasma-facing components. It would be desirable that many colleagues of the FEMaS community who attended PFMC-13/FEMaS-1 for the first time would also participate in future events of this series.

35 invited lectures and oral contributions and 192 posters were presented by participants coming from research laboratories and industrial companies. 282 researchers from 27 countries from all over the world participated in the lively and intense exchange of results and new ideas. An additional objective of the series of PFMC workshops was and is to encourage participation of young talented scientists and to spark their interest in this field. For that reason, the workshop started on its first day with a tutorial session. Experts in their respective fields presented in total 8

introductory lectures ranging from the basics of plasma-wall interactions to the engineering of plasma-facing components for ITER. Although originally intended for students and newcomers in the field these tutorial lectures enjoy also great popularity among senior scientist and are in the meantime an indispensable ingredient and a trademark of this workshop series.

The event was organized by the Max-Planck-Institute for Plasma Physics (IPP), Garching and received substantial financial support from the European Commission through FEMaS. We are very thankful to the staff of IPP who helped with the organisation. Our most cordial thanks and gratitude are going to Mrs. Christina Stahlberg and Mrs. Jutta Koser for their help in the organisation and at the front desk. Our most sincere words of appreciation are going to our colleague Elmar Neitzert who was in charge of the administrative organisation.

The present proceedings of PFMC-13/FEMaS-1 contain in total 83 peer-reviewed publications covering the contents of most of the oral presentations and of a number of poster contributions which were pre-selected by the programme committee. The papers reflect the development and actual status of the field. We thank all participants for their contributions and we particularly thank the referees for their systematic and diligent review of the submitted articles. It is due to their commitment and punctual return of reviews that the proceedings can appear in this relative short time after the meeting.

In a meeting of the programme committee during the conferences a few changes in the committee composition were decided. Paul Coad retires and leaves the programme committee. We cordially thank Paul Coad for his long-time service as a committee member and wish him the very best for the future. We are very happy that Dr. Guy Matthews (CCFE, Culham, UK) accepted the invitation to be his successor. Furthermore, to strengthen the international character of the event, it was decided to invite an additional representative from Japan to the programme committee. Prof. Noriyasu Ohno from Nagoya University accepted the invitation. To maintain the close contact to the FEMaS community the programme committee further decided to invite Dr. Christian Linsmeier from IPP, Garching. Another important decision was taken. In view of the size that the event has reached it was decided to change the name from workshop to conference. So the next event in this series will be PFMC-14 conference. It will be organised by FZ Jülich and most probably take place in Aachen in spring 2013.

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Participants of PFMC-13 / FEMaS-1