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The status of collaborative DSOL experiments is reviewed in Section 1.2. 7 DSOL proposals are running, 4 were proposed for closure, with 1 new proposal (divertor detachment modeling) launched.

The next meeting of the Div/SOL Topical Group will take place in Seoul, Korea, October 2010, coordinated with the timing and location of the IAEA conference. It will include joint sessions with other TGs (Pedestal, MHD, Energetic Particles).

Finally, thanks to the efforts at the IO all presentations given at DivSOL TG meetings since the first meeting in 2002 are now available on the ITER hosted ITPA Sharepoint website (https://portal.iter.org/departments/FST/ITPA/SD/Pages/default.aspx).

Contents

1. Meetings and reports

The summary report and all presentations given at the 13th meeting of the ITPA Div/SOL TG, can be found at https://portal.iter.org/departments/FST/ITPA/SD/SD/default.aspx?InstanceID=1 and only the executive summary is repeated here. A summary of results on IEA/ITPA co-ordinated experiments was also presented at the December 2009 planning meeting for these experiments and will not be repeated here.

1.1 Report on the 13th Meeting of the ITPA SOL and divertor physics Topical Group, San Diego, USA

The meeting was held over the period December 14-17, 2009 in San Diego. The local coordinator was Russell Doerner of the PISCES laboratory at UCSD. The meeting lasted 4 days and was split between discussions on the SOL/div R&D plans in support of ITER urgent needs and several research topics. There were over 50 participants.

In previous meetings we have examined the effect of substrate temperature on the fuel retention in co-deposits. At this meeting we shifted the emphasis to what fuel can be removed when one heats the substrate after co-deposition While the various possibilities for the substrate condition before baking are numerous (varying mixes of materials and in different ratios, varying temperatures at co-deposition) when one examines H/Be co-deposits with low C fractions (below a few %) the co-deposits act like pure Be in that ~90% of the H can be desorbed at bakes of 350C. However, for higher C concentrations in the co-deposits carbides form which both means less initial retention in the co-deposit but also almost none of the retained H is removed up to 1000C. Oxygen baking at 350°C results in C and H removal from co-deposits but no removal of Be. Heating of surfaces to high temperatures (1000°C) may be feasible by removing the plasma wetted surface around the chamber, strike point sweeping and heating during disruptions (planned and unplanned). Oxygen-radicals produced by ECR discharges appear efficient at removing C from gaps (as opposed to surfaces where O bake is more efficient).

At this meeting we also reviewed the many results obtained from the studies of the trajectories of injected dust based on DSOL-21 similar, or the same, dust was injected on a number of tokamaks (e.g. MAST, DIII-D, TEXTOR) and the results indicate a dependence of the trajectory on the mass/Z of the material. Initial modelling studies reproduce a number of the dust trajectory characteristics but apparently there are still too many unknowns. It was agreed that for proper comparison with modeling more effort is needed to develop injection at a known velocity/direction and to make sure a 3D trajectory can be followed by appropriate stereoscopic views. The study of the mechanisms for dust generation is in much poorer state due to lack of diagnostics. Some simple experiments

involving a gridded analyzer bei

done and would help ITER verify that radiation flash heat loads can be broadened by going to more than one MGI port.

The study of the effect of RMP on heat loads and the SOL profiles is only in its infancy. The little information we have garnered so far seems to indicate the SOL is not strongly affected - that the SOL profiles are L-mode like. More data is needed from the various experiments.
We also reviewed the current dataset for limiter plasma SOL profiles. While the data is consistent with models one could easily argue that the consistency is poor - the implication being that either a first-principles model is needed or better data from a range of tokamaks. Certainly better measurements of Ti are needed to pin down that power flow channel. With regard to the question of the effect of species (H, D, He) on SOL profiles the answer is minimal with some broadening reported for He JET plasmas. Lastly, the scaling of power flows to the main chamber surfaces was examined as a function of dW/W, the ELM size in JET. Since larger ELMs carried a bigger fraction of their energy farther out in the SOL more data is needed on a number of machines and better modeling in order to determine how this effect would scale to ITER.

1.2 IEA/ITPA multi-machine collaborations

The status of the DSOL experiments is summarized below (red : closed DSOL, blue : ongoing DSOL, green : new DSOL).

- x DSOL-2 Chemical erosion under ITER-like divertor conditions (semi-detached) (S. Brezinsek)

Proposal: TEXTOR, JET, AUG, DIII-D, Magnum PSI

- x DSOL-8 ICRF Conditioning for hydrogen removal (N. Ashikawa)

Proposal: LHD, HT-7, EAST, AUG, TEXTOR, TORE SUPRA, JET

- x DSOL-9 Tracer injection experiments to understand material migration (V. Philipps)

Proposal: JET, DIII-D, TEXTOR, AUG

Disruption mitigation experiments (D. Whyte)

- x DSOL-12 Reactive gas wall cleaning (P. Stangeby)

Proposal: TEXTOR, HT-7, EAST, DIII-D

- x DSOL-13 Deuterium codeposition with carbon in gaps of plasma facing components (K. Krieger)

Proposal: data from AUG, TEXTOR, MAST, DIII-D, TORE SUPRA, C-MOD

Ongoing DSOL, with new experiments planned, include : DSOL2 on chemical erosion, DSOL8 on ICWC (TS, TEXTOR, AUG, JET), DSOL9 on material migration (^{13}C tracer experiments in TEXTOR, AUG, JET and associated modelling), DSOL12 on O cleaning (lab experiments + TEXTOR, DIIID), DSOL13 on gaps (TEXTOR, AUG, TS).

DSOL14, 15, 16, 17 have been closed.

Recently launched DSOL (DSOL20 on divertor detachment and DSOL21 on dust injection) have started (DSOL21 : experiments performed in MAST, TEXTOR, LHD, NSTX; DSOL20 : data mining performed, experiments under definition)

The new DSOL 22 (multi code validation against experiment for improved detachment modelling) will replace the closed DSOL 14 (Multi-code, multi-machine edge modelling and code benchmarking) with a strong focus on the physics of divertor detachment, the reference case for the ITER scenario.

2. High Priority Research Areas

As mentioned in the executive summary, the strategy adopted by the SOL/Divertor TG to address urgent ITER R&D needs in the plasma-wall interaction area, has been to establish a set of high priority R&D areas which parallel those identified by ITER IO. Leaders have been identified to drive the overall research activity in each topical area. They have selected a number of subtasks, for which further coordinators have been appointed if required.

The table below compiles the five targeted R&D areas, summarising the subtasks which have been identified to constitute a work plan in each area. This table was already included in the 2009 CC report but is now updated to indicate which subtasks have been successfully completed, which are proceeding well but are not yet considered complete and which have only achieved moderate progress. This is indicated in the "Timescale" column by a cell colour with green corresponding to areas where significant progress has been achieved since the Task Groups were established, orange

	4. T-removal by outgassing to 350C – the baseline ITER divertor bakeout temperature Extensive studies done for Be closed. Oral paper PSI and IAEA 2010 – re-open specific task to investigate what is the "optimum" combination for the ITER operating temperature and bakeout + ac co-deposition of D into Be layer (in TVA apparatus) simultaneously	1-2 years	High
	5. Influence of mixed impacting species on fuel retention Studies performed for Be+ on W and Be+ on C as well as He ions on W closed. Oral paper PSI and IAEA 2010	1-2 years	High
	6. T-removal potential of disruption heating Data for unmitigated disruptions available (3 PSI 2010 papers). Need for mitigated disruption data b particle balance difficult to perform.	1-2 years	Medium
	7. Fuel retention in gaps New data available from TS and TEXTOR. Modelling ongoing (PSI2010 papers)	2-4 years	Medium
	8. Isotope exchange/tailoring using plasma discharges New data from JET (oral paper PSI2010)	1-2 years	Medium
	9. Carbon removal capability and associated risks Oxygen baking performed in DIII-D, data still unde analysis (post deadline PSI2010, IAEA 2010)	1-2 years	Medium
R&D Topic Area	Subtask	Timescale	Priority
Tungsten Leaders: A. Kallenbach Y. Ueda	1. Impurity generation due to ICRH operation New diagnostics and antennas to come in C-Mod AUG	2-4 years	High
	2. Melt layer behaviour and effect of divertor target damage on subsequent operation Experiments performed in TEXTOR, AUG and C-Mod. Negotiations ongoing with JET for ILW expts in 2011/2012.	1-2 years	High
	3. Balance between ELM driven impurity sources and outflux due to ELM flushing Detailed work performed for AUG (oral paper at PSI2010). To be driven by Pedestal TG and IO contract	1-2 years	High
	4. Material mixing, cracks, surface morphology changes, blistering Good progress: operational window for formation surface changes identified. Role of impacting He+	1-2 years	High

	elucidated Î closed 5. Tritium permeability and retention in neutron damaged W Significant progress on measurement as a function of material temperature and flux: should not be an issue for T inventory in ITER Î closed		

3. Future meetings