New linear plasma devices for an integrated approach to plasma surface interactions in Fusion Reactors

B. Unterberg[1], R. Jaspers[2,3], R. Koch[4], V. Massaut[5], J. Rapp[2] and D. Reiter[1]

Partners in the Trilaterial Euregio Cluster

[1] *Institut für Energieforschung-Plasmaphysik, Forschungszentrum Jülich, Association EURATOM-FZJ, D-52425 Jülich, Germany*
[2] *FOM-Institute for Plasma Physics Rijnhuizen, Association EURATOM-FOM, The Netherlands*
[3] *Eindhoven University of Technology, The Netherlands*
[4]*ERM/KMS, Association EURATOM-Belgian State, Brussels, Belgium*
[5] *SCK-CEN, Association EURATOM-Belgian State, Mol, Belgium*
Corresponding author: b.unterberg@fz-juelich.de

Plasma surface interactions will decisively determine the availability and thus the economy of a fusion reactor because of their impact on lifetime of the first wall (erosion) and on safety (tritium retention and dust production). In view of plasma surface interactions in ITER and DEMO new challenges have to be met: extended operational regimes with respect to particle and heat flux densities onto plasma facing components, both steady-state and transient, the use of toxic first wall materials (Be in ITER), the presence of Tritium, and the impact of neutron irradiation onto first wall materials.

To characterize plasma surface interactions under these conditions, dedicated plasma surface interaction facilities can be used, which allow for detailed investigations not possible in magnetic confinement devices. The Trilateral Euregio Cluster (TEC: FOM Netherlands, FZJ Germany and the Belgian Association) has developed a comprehensive concept and programme on plasma surface interactions to jointly tackle all the new challenges for plasma wall interactions with a well balanced suite of complementary linear plasma devices: MAGNUM-PSI at FOM, a divertor simulator with superconducting magnetic field coils allowing for particle flux and power densities relevant for the ITER divertor, VISION-I, a compact plasma device inside the tritium lab at SCK-CEN Mol, capable to investigate tritium plasmas and moderately activated wall materials, JULE-PSI at FZJ, capable to expose neutron activated and toxic wall materials to reactor relevant particle fluences and ion energies including post-mortem analysis of neutron activated samples, and the high heat flux device JUDITH for testing of activated and toxic samples.

This contribution shows the capabilities of the new devices and their forerunner experiments (Pilot-PSI at FOM and PSI-2 Jülich at FZJ) in view of the main objectives of the new TEC program:

- Investigation of erosion and re-deposition for lifetime prediction of plasma facing components and contamination of plasma;
- Investigation of tritium retention (and removal) for safety and fuel cycle;
- Investigation of dust production for safety;
- Investigation of structural integrity of the plasma facing components under the influence of high particle and heat fluxes including irradiation;
- Investigation of processes in boundary plasma;
- Development of advanced boundary plasma and plasma surface interaction diagnostics and control tools;
- Development and validation of computational models for interpretation and prediction to fusion reactors.