Understanding the influence of N₂ in a semi-detached ITER divertor-relevant hydrogen plasma by means of Magnum-PSI and numerical simulations.

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Experiments have shown that impurity seeding in the divertor leads to a net reduction of power loads onto the targets. Nitrogen is currently the leading candidate for impurity seeding in ITER. Volume processes such as molecular-activated-recombination (MAR) and electron-ion recombination (EIR), together with impurity radiation losses, may all contribute to achieve a detached plasma regime, in which the heat and particle fluxes are greatly reduced before reaching the surface. Little is known on the detailed physical-chemical processes occurring in such scenario in the presence of nitrogen. To study this complex system, an extensive global plasma model of H₂+N₂ chemistry has been set up on using PLASIMO code.[¹] The model has generated qualitative results highlighting new molecular-assisted reactions paths, suggesting N₂H⁺ as principal ion mediator and NH as main electron donor in charge exchange with H⁺. The resulting primary mechanisms are being implemented in Eunomia, a 3D Monte-Carlo code based on the test particle approximation method. All the fourteen vibrational states of H₂ are included, together with a large set of chemical reactions and species, namely H, H₂, N, N₂ and related ions. Dedicated experiments on plasma-surface-interactions in relevant conditions with nitrogen seeding are under preparation. Magnum-PSI is a unique linear plasma generator[²], located at DIFFER, capable of reproducing ITER-relevant plasma conditions. Moreover, it is possible to mimic ELM instabilities, giving insights into the effects of transient power loads on the equilibrium set up by recycling at the target.