The influence of N_2 in high density low temperature H_2 plasma by means of magnum-PSI and numerical simulations

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Experiments have shown that impurity seeding in the tokamak's divertor region 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 plasma-chemical processes occurring in such scenario in the presence of nitrogen. To study this complex system, an extensive global plasma model of H_2+N_2 chemistry has been set up on using PLASIMO code. The model has generated qualitative results highlighting new molecular-assisted reactions paths, suggesting N_2H+ 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 14 vibrational states of H_2 are included, together with a large set of chemical reactions and species, namely H, H_2, N, N_2 and related ions. Dedicated experiments on plasma-surface-interactions in relevant conditions with nitrogen seeding have been carried out, providing qualitatively the predicted results. Magnum-PSI is a unique linear plasma generator, located at DIFFER, capable of reproducing ITER-relevant plasma conditions.

Biography

Renato Perillo is a PhD student at the Dutch institute for fundamental energy research (DIFFER) among the group plasma edge physics and diagnostics (Nuclear fusion branch). He carried out his studies in Padova, Italy, obtaining a master's degree in environmental chemistry in 2014 (final mark 9/10). His thesis is focused on advance oxidation of volatile organic compounds (VOCs) by means of non-thermal plasma applications. From january to september 2015 he worked as guest researcher in computational plasma physics with the EPG group at the Eindhoven University of Technology, where he developed an extended global plasma model of low temperature hydrogen plasma. Since November 2015 he is employed at differ institute, working on plasma detachment and impurity seeding using numerical simulations and the linear plasma device magnum-PSI, a unique machine capable to mimic the plasma-surface interactions foresee to occur in ITER.

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