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Optimization of the impurity seeding recipe in terms of power dissipation, core radiation and fuel dilution with Ar and N seeded SOLPS 5.0 simulations for ASDEX Upgrade

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In a next step fusion device like ITER or DEMO, the unmitigated power loads at the divertor targets will considerably exceed the allowed material limits which are foreseen to be in the order of $5-10\,\mathrm{MWm}^{-2}$. Therefore, to prevent severe damage of plasma facing components and erosion of target material, a significant amount of power has to be exhausted via impurity radiation. For this purpose, it will be important to identify an optimum seeding recipe which provides sufficient power dissipation, but at the same time only has a minimal impact on the confined plasma and the burn conditions. Therefore, in this contribution argon and nitrogen seeding is investigated and compared via SOLPS 5.0 modeling of ASDEX Upgrade H-mode plasmas. Impurity seeding scans are performed in which nitrogen shows considerably less core radiation compared to the argon seeding case at comparable divertor conditions (i.e., at similar target temperatures and peak power loads). However, at the same time nitrogen seeding leads to stronger fuel dilution. These properties can be explained by the different impurity radiation efficiencies and differences in the impurity density distributions. A trade-off between core radiation and fuel dilution can be achieved by mixing both impurities. A previous analysis of the impurity transport and the divertor retention revealed that the reaction of the main ion plasma flow on the impurities differs for argon and nitrogen which will be discussed in more detail. In addition to the impurity seeding scans, a scan of the input power is performed. Preliminary studies show a very different reaction of the plasma on the impurity seeding at higher input power which motivates a closer analysis of these high-power simulations.

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