Role of molecular processes and target configuration on plasma detachment in GAMMA 10/PDX

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Significant progress has been made on the understanding the synergistic effect of N_2 and H_2 puffing on plasma detachment in the divertor simulation experiments using the end-loss region of the tandem mirror device GAMMA 10/PDX. We have observed that a combination of N_2 and H_2 puffing led to a clear decrease of ion flux to the divertor target [1]. The observed spectrum emission from the NH radical and the detailed analysis of the plasma chemical processes involving N and N_2 related reactions indicate that N-MAR (Molecular Assisted/Activated Recombination) is predominantly enhanced by the dissociative recombination of NH_x^+ followed by H^+ charge exchange reaction with NH_x. The spatial distribution of these emissions and their time evolution have shown that such a molecular process contributes to the plasma detachment process. In addition, the impact of the angle of V-shaped target plate on the detachment is also presented. The target angle is expected to affect plasma detachment through the change of hydrogen recycling processes, as well as local neutral pressure build-up in front of the target, thus enhancing the N-MAR process via the atomic transfer ($NH_x^+ + H_2 \rightarrow NH_{(x+1)}^+ + H$), which provides efficient mechanisms for populating NH_x^+ molecular ions. This has been investigated for different target angles using the variable angle V-shaped target system. The results indicate that N_2 seeding is not only effective at enhancing radiation, but also promoting detachment via N-induced MAR processes. This may have significant implications for the development of divertor configurations in Tokamaks, Helical devices and a future Demo.

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