Experimental and modeling study of the impact of upstream D_2 puff on divertor detachment with argon seeding in EAST

Zhongshi Yang
Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP), China

This study investigates the impact of upstream deuterium (D_2) injection on impurity detachment behavior under argon (Ar) seeding conditions. Upstream D_2 injection exhibits a shielding effect on intrinsic impurities, significantly reducing core levels of tungsten (W), molybdenum (Mo), and associated radiation, demonstrating notable impurity shielding. Stable and deeper detachment was achieved under upstream D_2 injection, enabling reduced impurity accumulation in the core while maintaining good core confinement. SOLPS-ITER simulations reproduced experimental results and revealed the physical mechanisms underlying detachment enhancement and impurity shielding. D_2 injection increased impurity retention in the divertor, enhancing impurity line and neutral radiation, thus promoting detachment. Impurity retention depended on parallel impurity velocity, total ionization source intensity, ionization region shifts, and forces near the target. In partial detachment, increased impurity retention was primarily due to enhanced impurity velocity toward the target. Effective detachment and impurity shielding require optimizing the D_2 injection rate to avoid excessive impurity leakage.