Measurements of injected impurity assimilation during massive gas injection experiments in DIII-D

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Abstract. Impurities (H_2, D_2, He, Ne, or Ar) injected into steady (non-disrupting) discharges with massive gas injection (MGI) are shown to mix into the plasma core dominantly via magneto-hydrodynamic activity during the plasma thermal quench. Mixing efficiencies of injected impurities into the plasma core are measured to be of order 0.05–0.4. 0D modeling of the experiments is found to reproduce observed thermal quench and current quench durations reasonably well (typically within ±25% or so), although shutdown onset times are underestimated (by around $2\times$). Preliminary 0D modeling of ITER based on DIII-D mixing efficiencies suggests that MGI will work well in ITER with regards to disruption heat load and vessel force mitigation, but may not collisionally suppress runaway electrons.

PACS: 52.25.Vy, 52.35.Py, 52.55.Fa