Hypervelocity scramjet engines promise an efficient air-breathing propulsion system with access-to-space capability. Difficulties arise when operating a scramjet engine at high altitudes and flight Mach numbers, notably above Mach 10. Oxygen enrichment is a technique proposed to augment scramjet thrust under these adverse conditions, where a small amount of oxygen is pre-mixed with the fuel before injection. Reynolds-Averaged Navier-Stokes (RANS) simulations indicate that enriching hydrogen fuel with oxygen provides a performance increase in notable excess of that expected from simple analysis. This technique could be a key enabling technology for access-to-space scramjets. The reported benefit is completely dependent on changes to the turbulent mixing process, which is entirely modelled in RANS.

High fidelity Large Eddy Simulations (LES), which resolves a majority of the turbulent fluid motion, were performed to verify the modelled changes to the mixing process. It was found that without the addition of heat release, the increased shear due to enriching fuel with oxygen was offset by a reduction in vorticity generation due to shock interactions with the mixing interface.

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