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Modeling non-unity Lewis number effects in premixed flames GUILLAUME BLANQUART, California Institute of Technology, ED KNUDSEN, HEINZ PITSCH, Stanford University — The combustion of hydrogen in Low Swirl Burners (LSB) is considered as an alternative for power production for it is characterized by low emissions and high efficiency. However, lean hydrogen premixed flames are subject to thermo-diffusive instabilities induced by the large diffusivity of hydrogen. The numerical modeling of these flows remain challenging for the transition of small scale instabilities into large scale turbulent structures cannot be modeled by conventional theories. In this work, a model is presented for the simulation of premixed flames with non-unity Lewis number fuels. This model relies on the Levelset/Progress variable approach which was found perfectly suited for the modeling of premixed flames with close to unity Lewis number fuels such as methane. Combined with the solution of an additional transport equation for mixture fraction, this model is formulated and validated in simple 1D laminar premixed flames. The model is found to capture accurately global quantities such as burning velocity and flame thickness as well as mixture fraction fluctuations. Then, this model is applied in Large Eddy Simulation (LES) of a Low Swirl Burner of H_2/Air ($\phi = 0.4$). The simulation shows the formation of a strongly wrinkled flame with local extinction. The results obtained with this new formulation show significant improvement when compared with experimental measurements.

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