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Propagation of symmetric and non-symmetric lean hydrogen flames in narrow channels: influence of heat losses CARMEN JIMENEZ, VADIM KURDYUMOV, CIEMAT — Direct numerical simulations, including detailed chemistry and transport, are used to investigate the structure and stability of freely propagating lean hydrogen flames in planar narrow channels. Depending on the flame burning rate and the wall properties, the flame-wall heat exchange can result in flame extinction. For large heat losses only the fastest burning flames, corresponding to fast reactant flowing rates can propagate. We show that double flame solutions, symmetric and non-symmetric, can coexist for the same set of parameters. The symmetric solutions are calculated imposing symmetric boundary conditions in the channel mid-plane and when this restriction is relaxed non-symmetric solutions develop. This indicates that the symmetric flames are unstable to non-symmetric perturbations, as predicted before within the context of a constant density model. Moreover, the burning rates of the non-symmetric flames are found to be significantly larger than those of the corresponding symmetric solution and therefore the range of conditions for flame extinction and flashback also differ. This shows that assuming in CFD that the flame should reproduce the symmetry of the cold flow can have important safety implications in micro scale combustion devices burning lean hydrogen mixture.

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