Experiments and simulations of combustion in a thin flat cell

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The combustion process of the hydrogen-air mixture in a thin flat cell was studied both experimentally and numerically. The influence of the hydrogen volume fraction and the mixture equivalence ratio on the property of propagating flames were investigated in the Hele-Shaw cell consisting of two closely spaced parallel plates under the gap thicknesses of 7 mm, 5 mm, and 3 mm, respectively. In this work, the combustion of hydrogen–air mixtures with a volumetric hydrogen content of 10, 12 and 15% in the mixture was studied. Different combustion modes were discovered depending on the thickness of the gap and the concentration of hydrogen. A deflagration combustion mode, characterized primarily by the presence of connectivity of the reaction zone along its entire length, and a focal combustion mode, manifested in the form of individual flames moving both radially and circumferentially have been identified, as well as an intermediate regime, when the connectivity of the flame front is not observed, but individual sources propagate like cells on the flame front. Preliminary simulations of the combustion process of the hydrogen-air mixture in a thin flat cell with CABARET-COMBUSTION code and CREBCOM code are presented. Estimates of the flame front temperature distribution along different axes were done. Radiant heat transfer and heat loss models were implemented in the codes and its influence on combustion of lean hydrogen–air mixtures is shown.