Large scale visualization of unconfined H2-air deflagrations in non-homogenous mixtures

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Large-scale accidental releases of combustible gases may yield large composition heterogeneities. When leaks occur at several locations, or in the presence of complex geometries, multiple pockets of reactive gases may accumulate in certain locations, separated by non-flammable gases. The present study addresses the likelihood of a flame to propagate between such pockets of reactive gases.
The experiments focus on hydrogen-air flames. The separated pockets of reactive mixtures are achieved by using the soap-bubble technique. In order to visualize such events, we have implemented a large-scale shadowgraphy technique, which permits us to monitor the events over length scales of 2 m by 2 m. A 1600W arc lamp coupled with a high speed camera permitted to resolve the dynamics of this problem. The figure below illustrates our experiment. A spark plug ignites the gas in the center of the left bubble. A deflagration wave consumes the gas while the products expand and the soap bubble grows. Upon rupture of the soap film, the second bubble may ignite if sufficiently close to the first. We characterized the propagation conditions using a model developed based on the volumetric expansion of the bubbles. The model was found in very good agreement with the experimental data. Future work will address different geometrical configurations and gas compositions.

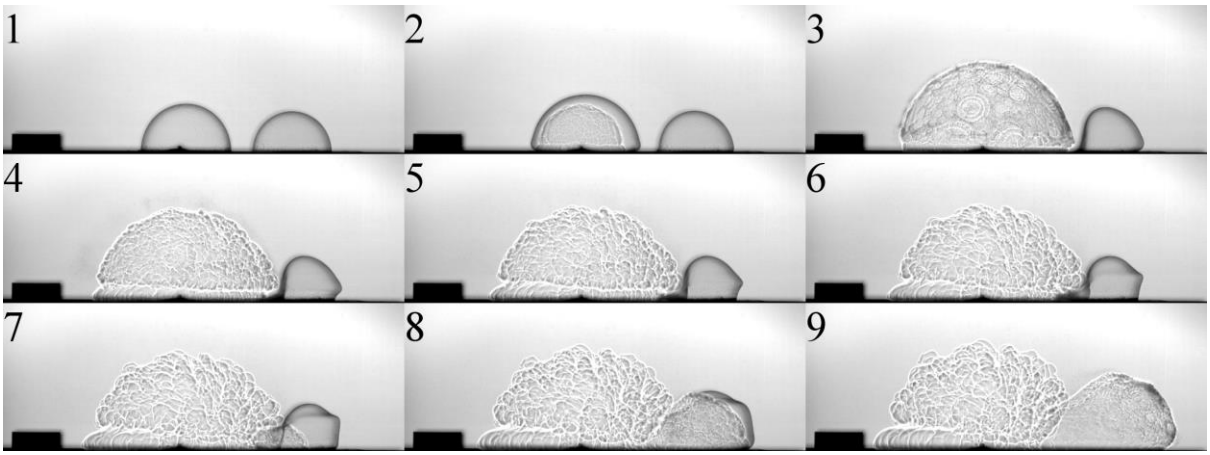

Figure. Shadowgraph images of stoichiometric hydrogen-air deflagrations. The field of view is 22.37 cm by 60.36 cm and the ignited bubble's radius is 7.23 cm and the second bubble's radius is 6.12 cm.

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