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Shock-initiated Combustion of a Spherical Density Inhomogeneity NICHOLAS HAEHN, JASON OAKLEY, DAVID ROTHAMER, MARK ANDERSON, UW - Madison, DEVESH RANJAN, Texas A&M University, RICCARDO BONAZZA, UW - Madison — A spherical density inhomogeneity is prepared using fuel and oxidizer at a stoichiometric ratio and Xe as a diluent that increases the overall density of the bubble mixture (55% Xe, 30% H_2, 15% O_2). The experiments are performed in the Wisconsin Shock Tube Laboratory in a 9.2 m vertical shock tube with a 25.4 cm $\times$ 25.4 cm square cross-section. An injector is used to generate a 5 cm diameter soap film bubble filled with the combustible mixture. The injector retracts flush into the side of the tube releasing the bubble into a state of free fall. The combustible bubble is accelerated by a planar shock wave in N_2 ($2.0 < M < 2.8$). The mismatch of acoustic impedances results in shock-focusing at the downstream pole of the bubble. The shock focusing results in localized temperatures and pressures significantly larger than nominal conditions behind a planar shock wave, resulting in auto-ignition at the focus. Planar Mie scattering and chemiluminescence are used simultaneously to visualize the bubble morphology and combustion characteristics. During the combustion phase, both the span-wise and stream-wise lengths of the bubble are seen to increase compared to the non-combustible scenario. Additionally, smaller instabilities are observed on the upstream surface, which are absent in the non-combustible bubbles.

Nicholas Haehn
UW - Madison

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