The Summer Undergraduate Research Fellowship (SURF) Symposium
6 August 2015
Purdue University, West Lafayette, Indiana, USA

High Pressure Combustion and Supersonic Jet Ignition for H2/air

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ABSTRACT

There are many incentives to increase the fuel efficiency of combustion processes. This paper looks at two available options to achieve this goal. The former aims to develop an experimental method that can analyze combustion at extremely high pressures to improve the understanding of high pressure H2/air combustion. Experimental data has been lacking a suitable combustion diagnostic to visualize high pressure combustion processes, making it difficult to improve the process. Improvement of x-ray diffraction tomography in a windowless combustor makes it possible to see flame propagation at high pressure. The procedure and chamber are still in the design phase, yet the preliminary research of beryllium windows and x-ray absorbance spectra indicate the feasibility and efficacy of this method. A technique of increasing the fuel efficiency in spark ignited engines is to use a supersonic jet from the spark chamber as the catalyst for combustion to trigger multiple ignition points in the main chamber for H2/air. This method requires a dual combustion chamber configuration with the pre-chamber containing the spark and various nozzle configurations to alter the structure of a supersonic jet. The pre-chamber is kept at a higher equivalence ratio, or more fuel, while the main chamber is filled with ultra-lean (phi 0.2 to 0.5) fuel/air. Ignition location, jet characteristics, ignition delay time and instability modes are studied. The usage of a supersonic jet for ignition in a spark engine was found to have a large effect on the combustion properties and induced a lowering of the lean limit.

KEYWORDS

High-pressure, combustion, supersonic jet, x-ray, absorption spectra