

Hydrogen-Assisted Combustion

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This research project (Funded under DOE Cooperative Agreement DE-FC25-04FT42233) focuses on developing the underlying fundamental information to support technologies that will facilitate the introduction of coal-derived hydrogen into the market. Two paths are envisioned here for hydrogen utilization in transportation applications. One is for hydrogen to be mixed with other fuels, specifically natural gas, to enhance performance in existing natural gas-fueled vehicles (e.g., transit buses) and provide a practical and marketable avenue to begin using hydrogen in the field. A second is to use hydrogen to enable alternative combustion modes, such as homogeneous charge compression ignition, to permit enhanced efficiency and reduced emissions.

This project on hydrogen-assisted combustion encompasses two objectives: (1) Optimization of hydrogen-natural gas mixture composition and utilization through laboratory studies of spark-ignition engine operation on H₂-NG and numerical simulation of the impact of hydrogen blending on the physical and chemical processes within the engine. The project makes use of facilities developed under a DOE-sponsored hydrogen fueling station project (DOE Cooperative Agreement No. DE-FC04-02AL67613, “Development of a Turnkey Commercial Hydrogen Fueling Station”) to provide both hydrogen and hydrogen enriched natural gas (HCNG) for the laboratory studies, and (2) Examination of hydrogen-assisted combustion in advanced compression-ignition engine processes, such as homogeneous charge compression ignition (HCCI) engine operation. This includes experiments in a multicylinder engine and multidimensional modeling of in-cylinder aero-thermo-chemical processes. The project will provide information on the viability and benefits of using hydrogen in an HCCI engine, will map out the useful HCCI operating envelope, and will explore the possibilities for broadening the HCCI operating envelope using direct in-cylinder pilot injection.



Figure 1: Ricardo “Hydra” Single-Cylinder Spark Ignition Engine used in the studies of hydrogen enriched natural gas combustion