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Hydrogen-Oxygen Active Pre-chamber using Water Electrolysis

Hydrogen pre-chamber engine cutting emissions while boosting efficiency for vehicles and power systems.

Researchers at Purdue University have developed an active pre-chamber ignition (PJI) engine for internal combustion engine applications. This technology enhances jet ignition at high exhaust gas recirculation (EGR) limits for better emission characteristics and ensures high combustion efficiency. Moreover, this novel technology significantly reduces emissions of traditional Spark Ignition (SI) engines by extending the dilution tolerance beyond the limits of both traditional SI and passive pre-chamber jet ignition engines. By eliminating the problems of standard SI, passive pre-chamber, and liquid-fueled active pre-chambers, this pre-chamber technology instead provides an invaluable solution for the automotive industry as power can be supplied by an existing car battery and bypasses the need for a separate fuel tank.

Technology Validation:

The hydrogen pre-chamber injection engine was validated using numerical simulations, including the formation of turbulent jets, by comparing results with experiments from passive pre-chamber systems. The numerical simulations showed that hydrogen can provide good stability in combustion and create an optimum jet, showcasing how the performance of the engine prevails in highly diluted conditions.

Advantages:

-Improved fuel economy and thermal efficiency

-Reduced nitrogen oxide emissions

-Promotes less greenhouse gases emissions

Applications:

-Automotive industry

Technology ID

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Category

Automotive & Mobility Tech/Fuel Injection & Combustion Control Systems
Automotive & Mobility Tech/Internal Combustion Engine Optimization
Energy & Power Systems/Hydrogen & Fuel Cell Systems

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-Power generation systems

-Low emission engines

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Intellectual Property:

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Utility Patent, 2025-07-31, United States

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