Laser-Induced Ignition Eliminates Need for Spark Plug

This photograph, exposed over several milliseconds, shows both the laser-induced spark and the subsequent ignition of the flame. (AFRL image)

AFRL researchers successfully demonstrated resonant laser-induced ignition of a propane-air flow mixture, a concept in an aircraft combustor that would eliminate the protruding spark plug. In place of the spark plug would be an insulated wall electrode where the fiber-optic-coupled laser enters and induces the spark, using the combustor wall as the ground electrode.

The innovative spark initiation scheme uses a relatively low-energy, single-pulsed ultraviolet laser to create a pre-ionized channel, allowing a relatively low applied voltage to create an electrical spark that directly follows the channel and ignites the fuel. Because the spark follows the channel, this may provide a more reliable ignition by delivering the spark to an optimal location inside the ignition volume with a rich fuel-air mixture.

The ultraviolet laser pulse is tuned to the precise wavelength to generate a pre-ionized path through the air via resonant enhanced multiphoton ionization (REMPI) affecting the molecular oxygen in the flow. In these initial laser-ignition experiments, the 10 nanosecond laser pulse created the pre-ionized path that generated breakdown and a spark within a microsecond. The eventual propane flame formed within milliseconds.

For additional information on this technology contact AFRL/RZ afrl.rz.techinfo@wpafb.af.mil, (937)255-3428. To receive more information about AFRL, visit the Homepage at www.wpafb.af.mil/afrl. (RZ-11-01_11-18) ***Propulsion/Diversity/Discovery***