188e Chemical Reactive Control of Hcci Engines

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This paper describes recent results from a study by our group, whose purpose is to investigate experimentally and numerically the ignition enhancement of CH4/air mixtures by C2 additives that can be produced in-situ by Oxidative Coupling of Methane (OCM). The major goal of the study is the improvement of the ignition characteristics of lean premixed natural gas (NG) combustion under Homogeneous Charge Compression Ignition (HCCI) engine-like conditions. In recent years, the Homogeneous Charge Compression Ignition (HCCI) engine has attracted notable attention. In HCCI engines, a homogeneous fuel-air mixture is introduced into the engine's cylinders, and is subsequently compressed until it is ignited. In addition to not needing sparkplugs for ignition, the main potential advantages of the HCCI engines are the significantly reduced soot and NOx emissions resulting from burning lean and homogeneous fuel-air mixtures. However, there are still significant technical challenges associated with the successful operation of HCCI engines, like high emissions of unburned hydrocarbons (UHC), and uncontrollable ignition timing, due to the fact that ignition is solely controlled by the chemical kinetics of the fuel. Of these two, the problem of the high emissions of UHC is a relatively minor one in HCCI engines, as it can be solved with exhaust gas after-treatment. The major problem that designers encounter, however, is controlling the auto-ignition timing. The emphasis in the study is on reactor design aspects and their implications for optimal engine operation. Both conventional and catalytic membrane reactors are investigated. Membrane reactors show significantly improved performance over their conventional counterparts. To validate the influence of reactor operating conditions on engine operation we investigate the combustion characteristics and efficiency of the resulting reactor mixtures under relevant HCCI conditions.