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Flame Kernel Growth and Related Effects of Spark Plug Electrodes: Fluid Motion Interaction in an Optically Accessible DISI Engine

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Abstract : One of the aspects that are usually neglected during the design phase of an engine is the effect of the spark plug on the flow field inside the combustion chamber. Because of the difficulties in the experimental investigation of the mutual interaction between flow alteration and early flame kernel convection effect inside the engine combustion chamber, CFD-3D simulation is usually exploited in such cases. Experimentally speaking, a particular type of engine has to be used in order to directly observe the flame propagation process. In this study, a double electrode spark plug was fitted into an optically accessible engine and a high-speed camera was used to capture the initial stages of the combustion process. Both the arc and the kernel phases were observed. Then, a morphologic analysis was carried out and the position of the center of mass of the flame, relative to the spark plug position, was calculated. The crossflow orientation was chosen for the spark plug and the kernel growth process was observed for different air-fuel ratios. It was observed that during a normal cycle the flow field between the electrodes tends to transport the arc deforming it. Because of that, the kernel growth phase takes place away from the electrodes and the flame propagates with a preferential direction dictated by the flow field.

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