Numerical Investigation of Soot Formation and Oxidation in Wankel Rotary Engine Using Particulate Mimic Soot Model

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The stringent legislation regulating pollutant emissions brings the industry and academia to invest significant efforts in finding feasible ways to reduce the carbon footprint, and to mitigate the NOx and particulate matter (PM) formation in internal combustion engines (ICEs). The focus of this effort is mainly concentrated on reciprocating spark-ignition (SI) and compression-ignition (CI) ICEs, alternative low carbon intensity fuels, waste heat recovery, novel combustion processes (such as homogeneous charge compression ignition), etc. However, other types of engines are also developed and used, one of which is the Wankel rotary engine. This type of ICE is known by its notably high-power density, but also by its incomplete combustion and difficulty to meet the emission requirements. The reported study has evaluated numerically the emission formation in Wankel engines, with an emphasis on the formation and oxidation of soot. To do so, a three-dimensional computational fluid dynamics (CFD) model of commercial Wankel engine coupled with detailed chemistry solver and with a particulate mimic soot model was built using the commercially available CONVERGE software. Prediction and analysis of the soot mass and size distribution in the baseline Wankel engine was performed. Likewise, the influence of the rotor design and spark-plug arrangement on particle emission was also investigated.