(1-11) Reduction Mechanism of NOx in Rich and High Turbulence Diesel Combustion

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ABSTRACT

This study investigated the reduction mechanism of NOx in diesel combustion. Rich and high turbulence combustion was formed experimentally using a rapid compression machine with changed swirl velocity v and equivalence ratio \( \phi \), and transient concentrations of NO and lower hydrocarbons were measured at each stage of combustion by a total gas-sampling method. High-speed photography and CFD computation were also employed for the analysis of the flame behavior and NO formation. Results show that the heat release rate is proportional to the concentration of light hydrocarbons produced by the thermal cracking of fuel (Fig.A1). As is well known that NO concentration gradually increase at the initial combustion stage and, at the end of diffusion combustion, the concentration keeps maximum level. However, on the rich and high swirl condition, NO concentration decreases during the diffusion combustion (Fig.A2). Analysis of the flame behavior shows that, under the rich and high swirl condition, a ring flame is formed inside the periphery of the chamber and the flame keeps the ring structure until the end of the combustion (Fig.A3). In the ring flame region, rich and high temperature mixture is formed. A large amount of thermally cracked hydrocarbons is confined in the flame and NO formation rate decreases. These results suggest that, in the local rich and high turbulence region, NOx emission should be reduced by a chemically reduction mechanism. The mechanism is caused by some chemical species formed through the fuel decomposition.