論文の概要

題 目 CHARACTERIZATION OF DIESEL SPRAY AND MIXTURE FORMATION PROCESSES UNDER SMALL INJECTION AMOUNT CONDITION

（微小噴射量条件下のディーゼル噴霧と混合気形成過程の特性に関する研究）

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The control of the air-fuel mixture formation process inside combustion chamber of modern common-rail direct injection diesel engines is the key factor for manipulating the overall efficiency and the emission. Studies focused on the spray during quasi-steady condition, in particular when the injection rate profile reaches steady condition; while rare research has been conducted on the spray with small injection quantity which the entire injection rate profile are under transient.

Besides, due to better accessibility of the imaging system and spray illumination, most research focused on single-hole injectors which are dedicated for the fuel spray observation. Due to the requirements of more accurate results which can reflect the conditions closer to a real engine, active research with the multi-hole injectors are carried out as well.

The novelty of this research lies in the systematic analysis of the effects of small injection amount for both the single-hole and multi-hole injectors. To present this work, the disseration is organized as follows:

Chapter 1 is entitled as “Introduction”. First of all, a review of previous works on the development of diesel common rail systems, nozzle internal flow, spray and mixture formation as well as experimental method were presented.

Chapter 2 is entitled as “Experimental apparatus, procedure and numerical method”. The experimental apparatus, optical measurement and numerical methods employed in this study are introduced in this chapter.

Chapter 3 is entitled as “Spray results of single-hole and multi-hole injectors under same rail pressure condition”. The effects of injection amounts for single-hole or multi-hole injectors were studied in this chapter under both evaprating and non-evaporating conditions.

Chapter 4 is entitled as “Spray results of single-hole and multi-hole injectors under similar injection rate profile”. The effects of spray velocity and structure on mixture formation were studied under similar injection rate condition by comparing the single- and multi-hole injectors.

Chapter 5 is entitled as “Nozzle internal flow and near-field spray simulation”. The numerical research were conducted to illuminate and analyze the spray and mixture behaviors found in Chapters 3 and 4.

Chapter 6 is entitled “Characteristics of spray development and mixture formation under split injection condition”. The effects of small injection amount on split injection was discussed. The phenomenon presented in split injection was analyzed by combining the results under different injection amount conditions.

Chapter 7 is entitled “Closure”. The main findings of this study were summaried in this chapter. In addation, the view and proposition on the future work has been advanced.