

# A Study on Improvement of Main Flame Ignition Performance by Multiple Pre-Discharge

Eiichiro Ohata<sup>1)</sup> Kazuhiro Oryoji<sup>2)</sup> Tomoyuki Hosaka<sup>2)</sup>

<sup>1)</sup> Hitachi Astemo, Ltd.

2520, Takaba, Hitachinaka-shi, Ibaraki-ken, 312-8503 Japan (E-mail: eiichiro.ohata.jt@hitachiastemo.com)

<sup>2)</sup> Hitachi, Ltd.

832-2, Horiguchi, Hitachinaka-shi, Ibaraki-ken 312-3393 Japan

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To reduce pollutant emissions in real driving conditions, Euro 7, for example, is expected to tighten emission regulations for cold start conditions. Engines installed in hybrid electric vehicles (xHEV) start often in a cold state due to frequent restart events, which increase hydrocarbon (HC) emissions.

In this study, the two-stage combustion support concept was proposed, which preheats the in-cylinder gas by applying multiple discharges and a pre-discharge during the intake stroke. The following conclusions were obtained through the numerical analysis and the experimental results in the single cylinder research engine. (Fig.1)

1) Numerical calculations of minimum ignition energy (MIE) and laminar burning velocity ( $S_L$ ) indicated the possibility of the combustion assistance by a pre-discharge during the intake stroke. (Fig.2)

2) It is assumed that partial combustion by multiple discharges during the intake stroke preheats the cylinder gas and promotes vaporization of the fuel, then main ignition performance during the compression stroke could be improved.

3) The effect of the multiple pre-discharge on suppressing IMEP cycle fluctuations and reducing HC emissions at cold engine start was verified by engine test. (Fig.3)

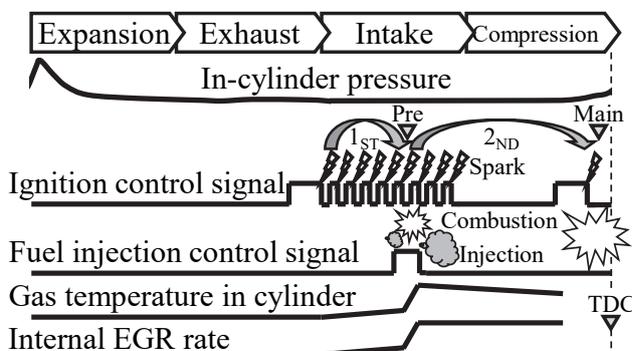


Fig. 1 Two-stage combustion support concept

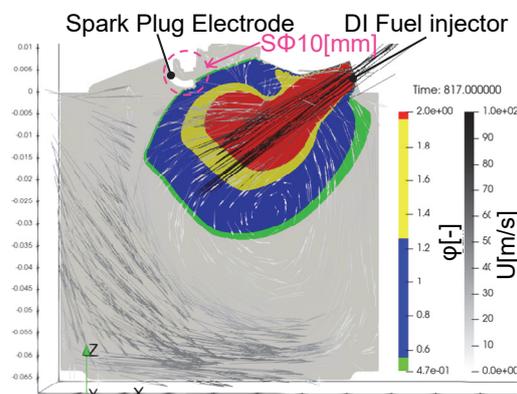


Fig. 2 In-cylinder gas condition

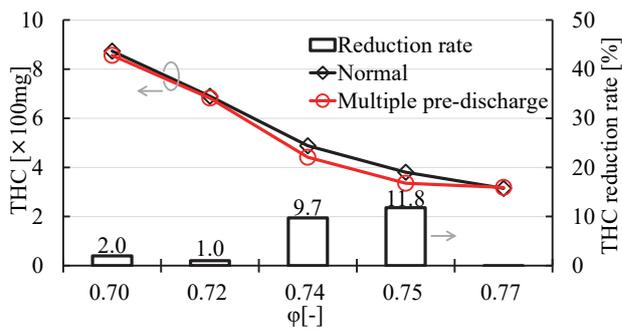


Fig. 3 Reduction effect of HC emissions