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Development of High-Response Heat Insulation Material Technology in Engine Combustion Chamber to Improve the Fuel Economy (First Report)

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To decrease cooling loss of engines and improve fuel economy, we are developing high-response heat insulation material technology using in engine combustion chamber wall surface. It is necessary for this material to low thermal effusivity and endure severe environment. We examined the materials configuration which introduced voids into resin base materials as high-response heat insulation material. In addition, We applied high-response heat insulation material to single cylinder gasoline engine parts and examined a fuel economy improvement effect.

As a result, we got the following findings.

(1) We investigated the influence that thermal effusivity and thickness of high-response heat insulation material gave to ISFC improvement and torque change rate by simulation study. As a result of this examination, ISFC improvement increased exponentially as thermal effusivity decreased (Fig.1), and heat insulation thickness that achieves both ISFC Improvement and torque drop prevention was roughly in the range of 40 to 100μm.

(2) We developed high-response heat insulation material of the configuration which contained hollow particles in silicone resin (Fig.2). The thermal effusivity of this material contained approximately 50vol% hollow particles was 0.5 $kJ/m^2/s^{1/2}/K$. In addition, it was confirmed that detachment and come off not arising from substrate after heating of 773K, and the material did not have damage by pressure of 30MPa.

(3) As a result of investigating ISFC improvement and Torque change rate by single cylinder gasoline engine, it was confirmed that ISFC improvement was 2.7% to 4.7% (Fig.3), and Torque change rate was 0.9% drop (Fig.4). These experimental results almost agreed with simulation results.

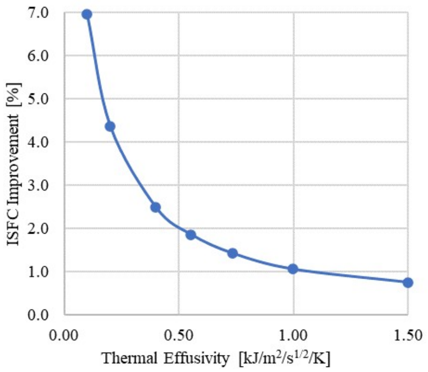

Fig.1 Relationship of Thermal Effusivity and ISFC Improvement
(2000rpm, IMEP 500kPa, Insulation Thickness 50μm)

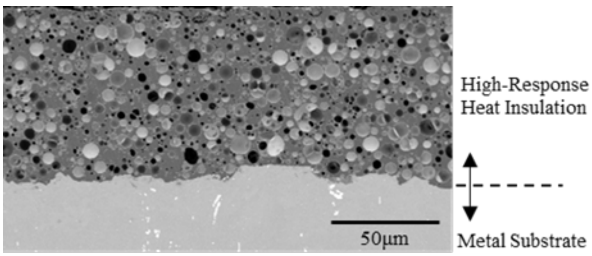

Fig.2 Cross-Sectional SEM Image of
High-Response Heat Insulation Material

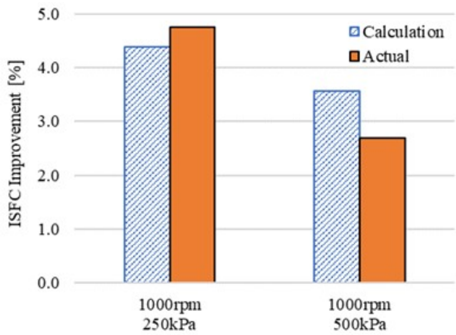

Fig.3 Result of ISFC Improvement

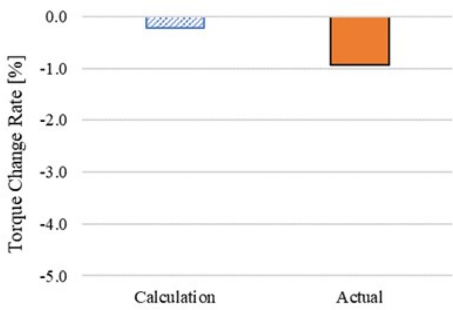

Fig.4 Result of Torque Change Rate
(2000rpm-WOT)