論 文 の 要 旨

題 目　WALL ADHESION CHARACTERISTICS OF FUEL SPRAY IMPINGING ON FLAT WALL IN CROSS-FLOW AMBIENT UNDER SPLIT INJECTION CONDITION
（横風中で平板壁面に衝突するスプリット噴射燃料噴霧の壁面付着特性）

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In Direct Injection Spark Ignition (DISI) engines, the small cylinder volume and high injection pressure result in high-pressure fuel injectors introducing fuel into the cylinder. This leads to fuel spray coming into contact with and adhering to the cylinder walls, creating flat-wall wetness phenomenon on the piston surface and cylinder wall. The fuel adhesion phenomenon after wall impingement negatively affects the fuel spray mixture formation, fuel consumption, and pollutant emissions, thereby reducing the combustion efficiency of the engine.

To improve the high combustion efficiency and low emissions of gasoline engines, a comprehensive experimental study was conducted in a high-pressure wind tunnel. The study examined the effects of different cross-flow velocities, injection strategies, and wall impingement distances on the characteristics of spray impingement structure and fuel adhesion distribution. The Particle Image Velocimetry (PIV) technology is utilized to assess cross-flow field uniformity at different velocities. The continuous wave laser-Mie scattering technique was constructed using a high-speed camera and laser sheet light to observe the wall-impingement spray structure in the vertical plane. The fuel adhesion characteristics of the wall spray were examined using the Refractive Index Matching (RIM) method. Subsequently, the area, mass, and thickness of fuel adhesion are calculated using MATLAB.

The findings demonstrate that split injection can decrease the fuel adhesion thickness, area, and mass under cross-flow field conditions. High cross-flow velocity promotes the fuel adhesion shape to be elongated strips. In the early stage, the growth rate of the fuel adhesion area increases with an increase in cross-flow velocity. In the later stage, the decrease rate in the fuel adhesion area initially increases with an increase in the cross-flow velocity; however, when the critical velocity threshold (20 m/s) is exceeded, the decrease rate in the fuel adhesion area tends to stabilize.　In addition, the cross-flow promotes the volatilization of spray and fuel adhesion, thereby decreasing the fuel adhesion mass over time. The average fuel adhesion thickness then accordingly decreases with the increase in the cross-flow velocity and impingement distance in the later stage. In the later stages, the fuel adhesion area increases proportionally with the impingement distance. The fuel adhesion mass and ratio of fuel

adhesion mass increase with the increase of the impingement distance. Additionally, the spreading of fuel adhesion was proposed to evaluate the fuel adhesion distribution. The spreading of fuel adhesion increases with the increase of the impingement distance. In the context of carbon neutrality, this study underscores the importance of optimizing fuel injection conditions to reduce emissions and fuel consumption.