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Analysis of Spray Characteristics of Direct Injection SI Engines under Low Temperature Conditions (Second Report)

- High viscosity of adhered liquid film due to low wall temperature -

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In direct injection spark ignition engines, PM reduction under cold conditions is important, and controlling liquid film adhesion by wall impingement sprays is a key issue. In this study, to control the amount of liquid film adhesion by wall impingement spray, fuel film analysis method was developed applying the total internal reflection laser induced fluorescence (TIR-LIF) method, which can measure film thickness and film temperature that change unsteadily during the film formation process. Simultaneous decrease of fuel temperature and wall temperature increases the We number of spray droplets, which increases the amount of splash by wall impingement and decreases the amount of film adhesion. However, the effects of fuel spray and fuel film temperature on the film formation process of impinging wall spray under low temperature conditions remain to be revealed. In this paper, the droplet groups impinging on the wall were set in the same condition by changing the wall temperature only. The effect of the temperature change on the film formation process was analyzed by measuring the film temperature and thickness of the spray droplets during their impingement on the wall. Figure 1 shows the results of the analysis of liquid film thickness and liquid film temperature. It was found that as the liquid film temperature decreased, the amount of droplet adhesion to the liquid film decreased because the amount of splash increased when droplets impinged on the film.

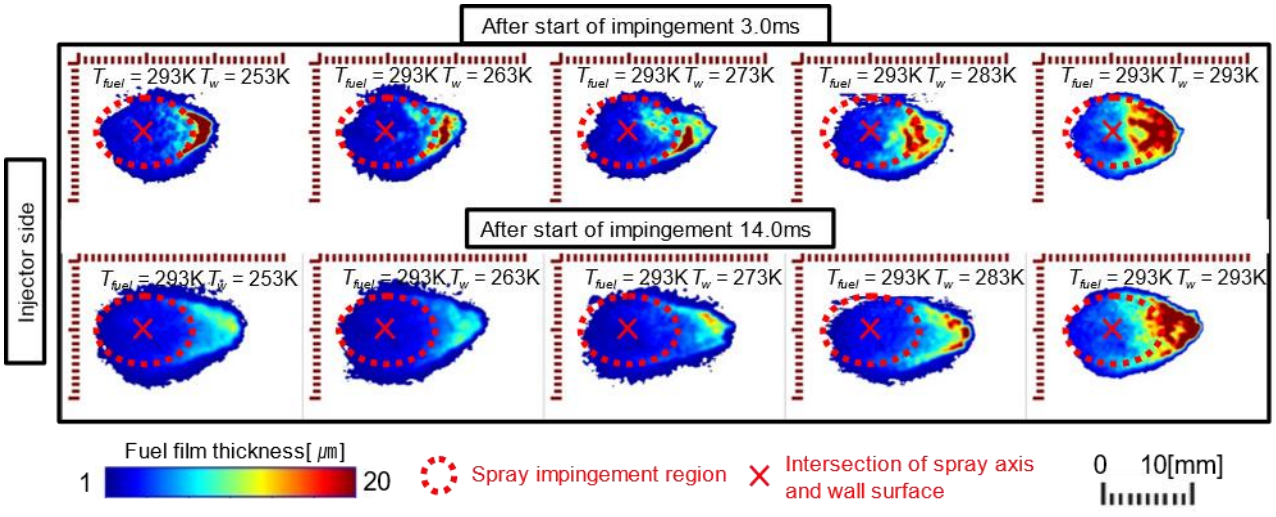

Fig.1 Analysis results of fuel film thickness at time after start of impingement 3.0 and 14.0 ms (ΔP_{inj}:10 MPa, t_{inj}: 3.3 ms, Q_{inj}: 3.45 mg, α_w: 45 deg., Z_w: 57 mm. T_a: 293 K, ρ_a: 1.16 kg/m^3, T_f: 293 K, T_w: 253, 263,273, 283, 293 K,)