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Development of a Prediction Model of Soot Particle Size Distribution applicable for Design Calculations of Internal Combustion Engines (First Report)

- Validation for *iso*-octane/*n*-heptane/toluene blended Fuels -

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In previous work, we have proposed a soot mass prediction model applicable for design calculations of internal combustion engines. In this study, we expanded this model and developed a new model which can predict the soot particle size distribution. The proposed model, AICE-PN, consists of 130 chemical species and 866 elemental reactions, and can be used for combustion calculations of *iso*-octane/*n*-heptane/toluene/ethanol blended Fuels

The model was validated for experimental results measured by using burner stabilized stagnation flames (BSS flames) for *iso*-octane/*n*-heptane/toluene blended fuels. The BSS flame experimental device consists of a premixed air duct equipped with sintered metal and a flat plate on which the pre-mixture flow impinges. Premixed flames were formed in a flow impinging on a temperature-controlled flat plate. By changing the distance *H* from the burner outlet to the flat plate, the residence time from behind the flame to the sampling point can be varied. In other words, it is possible to evaluate particles at different growth periods. Numerical calculations for BSS flames were perfomed by using ANSYS Chemkin-Pro. The AICE-PN model and the CRECK model were used as the soot prediction model. For the model validation, the experimental results for *n*-heptane/toluene blended fuels measured by Tang et al., and the experimental results for *iso*-octane/toluene blended fuels measured in this paper were used. Figure 1 shows the model calculation results for *n*-heptane/toluene blended fuels, and Fig. 2 shows the model calculation results for *iso*-octane/toluene blended fuels, along with the experimental results. From these figures, it was shown that the proposed model can reproduce the particle formation characteristics with changes in the fuel mixing ratio, the residence time, and the equivalence ratio. On the other hand, it was found that there is room for improvement in the polycyclization process for pure *iso*-octane and *n*-heptane flames.

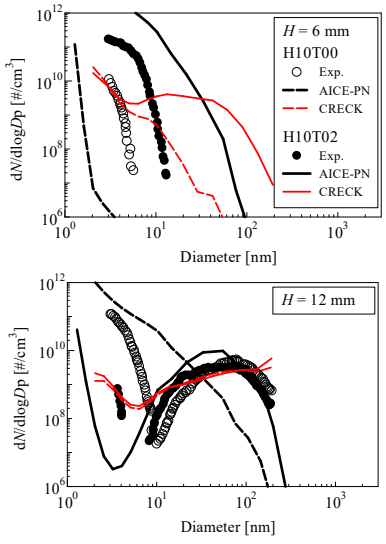
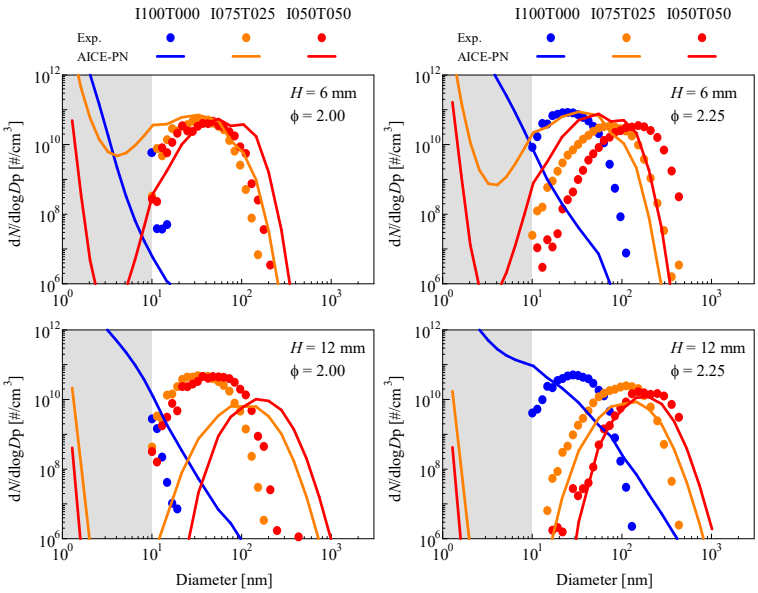


Fig. 1 Particle Size Distribution, *n*-heptane/toluene blended fuels



(a) ϕ = 2.00 (b) ϕ = 2.25

Fig. 2 Particle Size Distribution, *iso*-octane/toluene blended fuels