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Evaluation of Solid Particle Number and Size Distribution from Light-Duty Vehicles with Gasoline Direct Injection Engine

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According to the RDE test procedure for passenger cars, the validation test of Particle Number Portable Emissions Measurement System (PN-PEMS) shall be conducted on a chassis dynamometer and the result of PN emissions at the tail-pipe by a PN-PEMS shall fulfill the permissible tolerance compared with the result of PN emissions at the dilution tunnel by a stationary PN measurement system. However, the PN emissions at the tail-pipe and the dilution tunnel could be different due to particle loss. In this research, in order to investigate the influence of particle loss on the PN evaluation results, the solid PN emissions and the particle size distribution at the dilution tunnel and the tail-pipe during the WLTC cold tests of GDI passenger cars on chassis dynamometer tests were evaluated.

Fig. 1 shows the PN emissions at the tail-pipe (by EEPMS 3095, TSI) and at the dilution tunnel (by CS-EEPS which is an EEPS with an external catalytic stripper, SPCS2300 and SPCS2310). Fig. 2 shows the PN emissions for each phase and overall by EEPMS and CS-EEPS. Note that the PN emissions in Fig. 2 are normalized by the PN emissions at the tail-pipe. According to the results, the PN emissions of each vehicle (Vehicle NA and TC) at dilution tunnel were about 35% lower than the PN emissions at the tail-pipe and the smaller particles showed the larger the particle loss ratio. Furthermore, the particle loss during low phase was larger than other phases. It is likely that the lower temperature and exhaust flow rate in the low phase caused the larger particle loss regarding thermophoresis, condensation of water and diffusion in the transfer tube between the tail-pipe and the dilution tunnel. The possibility was shown that the particle loss would be reduce by heating the transfer tube.

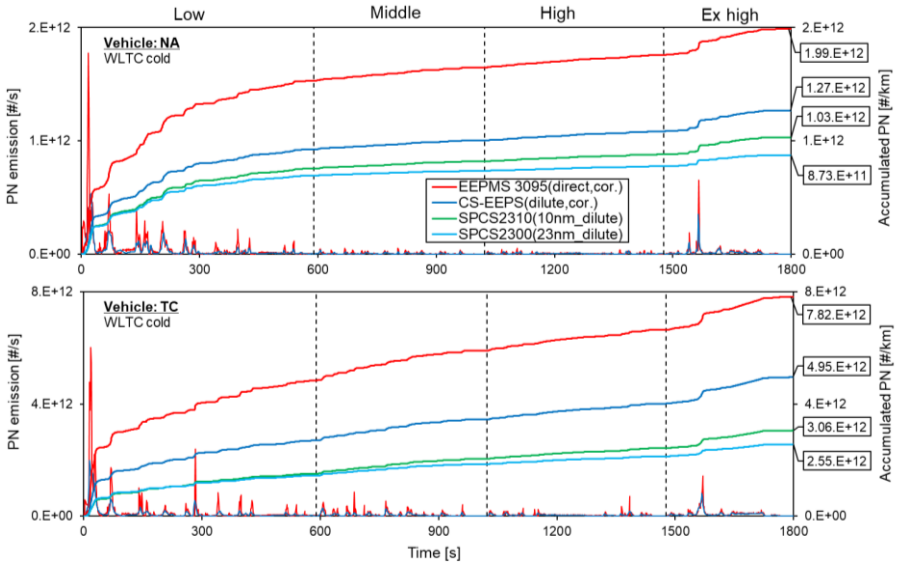
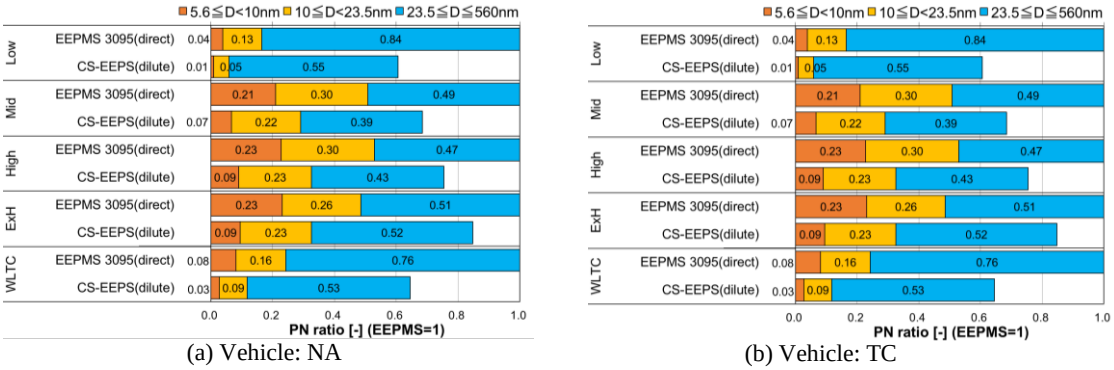


Fig.1 PN Emission of Direct (tail-pipe) and Dilute (dilution tunnel) Measurement



(a) Vehicle: NA (b) Vehicle: TC

Fig. 2 PN Emission Ratio of each Phase and Overall