



West Virginia University

CAFE

Center for Alternative Fuels,
Engines and Emissions

Characterization of Particle Number (PN) Emissions from Modern Gasoline Vehicle during Highly Transient Vehicle Activity

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What we already know about GDI-PM is

- ⇒ Larger fraction of elemental carbon (EC) in GDI vs. PFI
- ⇒ Elevated concentration in particle # (PN) in GDI
- ⇒ GDI emit more particles than DPF equipped diesel vehicle, in some cases

Objectives of this study

- To study the solid PM emissions rate, morphology and chemical characteristics from GDI vehicle during rapid acceleration events of the vehicle in FTP75, US06 and real world city driving cycle—MGW (Morgantown, USA)
- To compare results to a diesel vehicle equipped with DPF

KNOWLEDGE - GAP

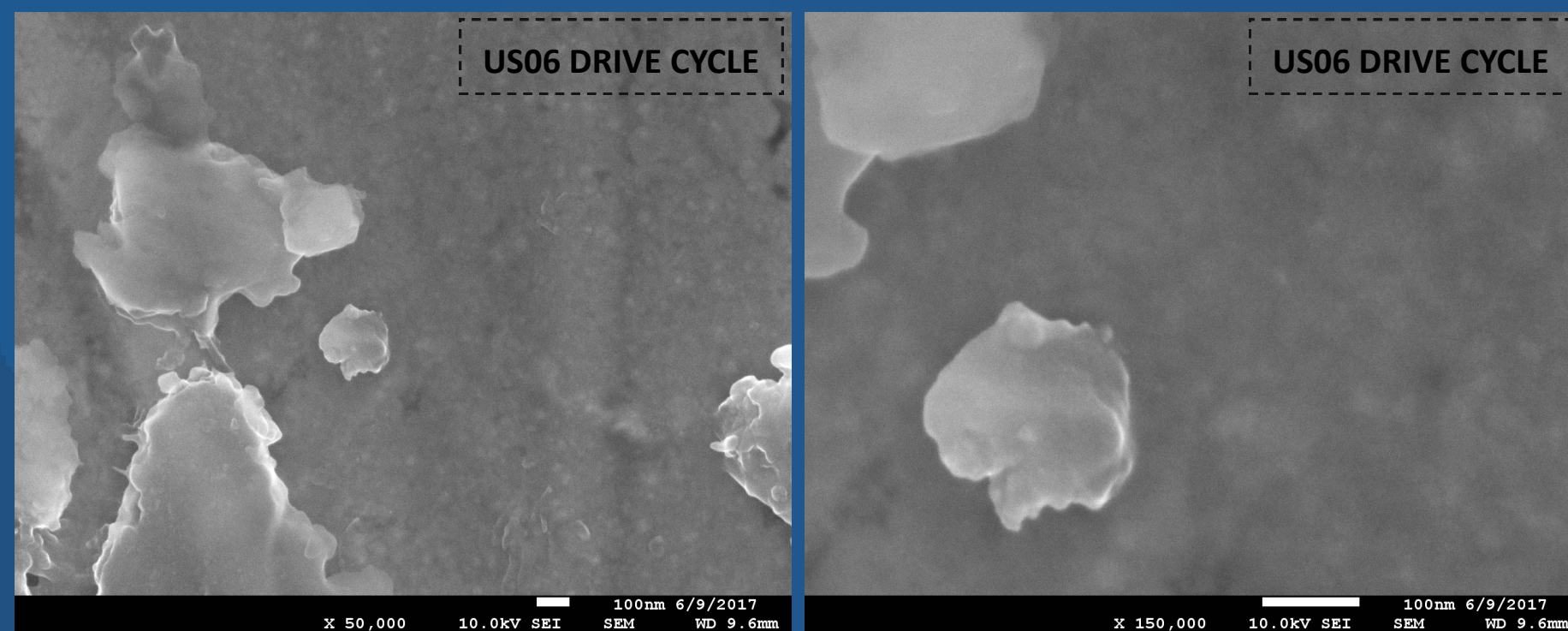
PM from Gasoline Direct Injection (GDI) vehicle during transient vehicle operation

TEST SETUP

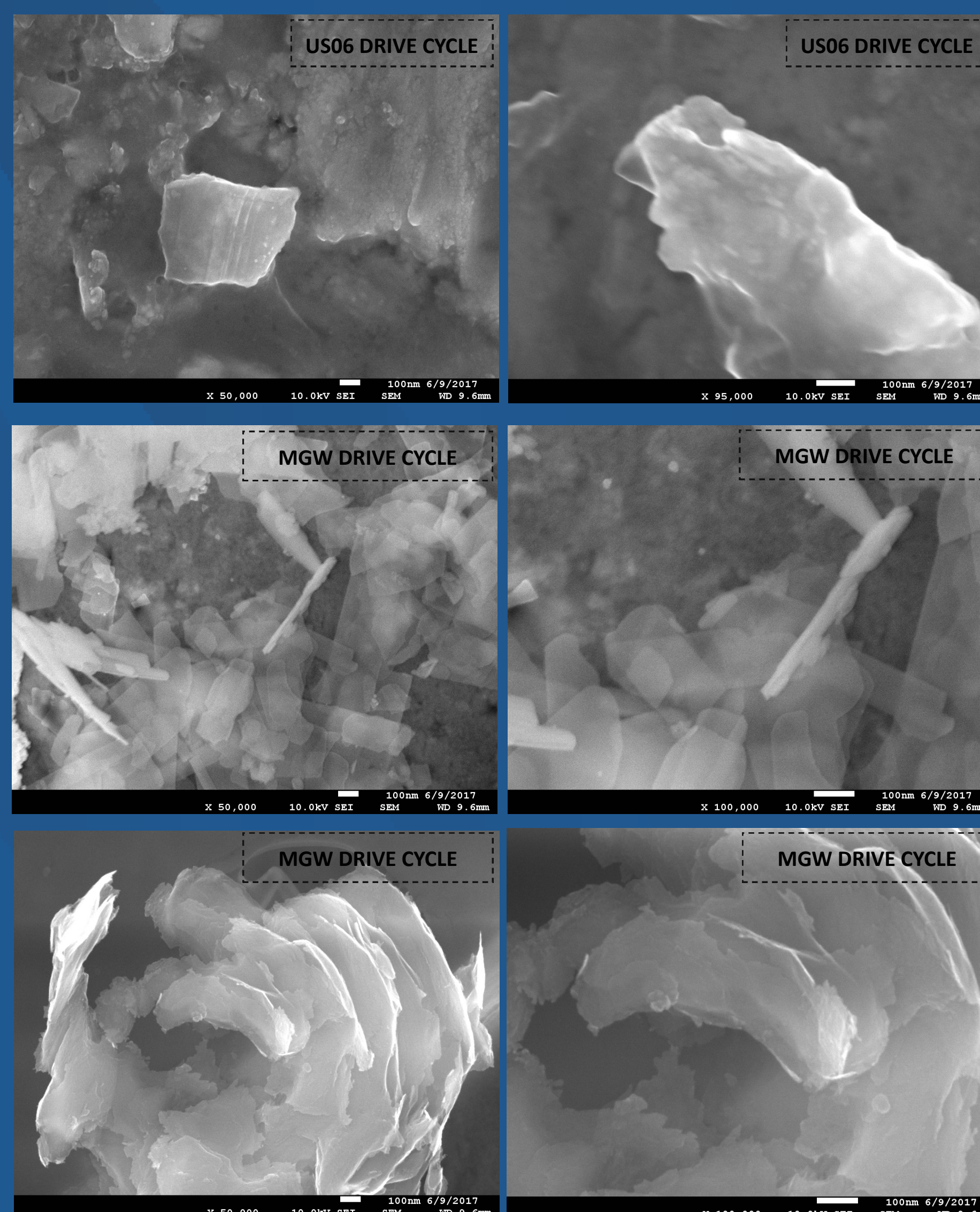


Would future GDI engines require particulate filters to meet emissions standards ?
What are the engine operating characteristics that contribute to high PM emissions in GDI engine ?
How does GDI PM characteristics look like during different acceleration regimes of vehicle operation ?

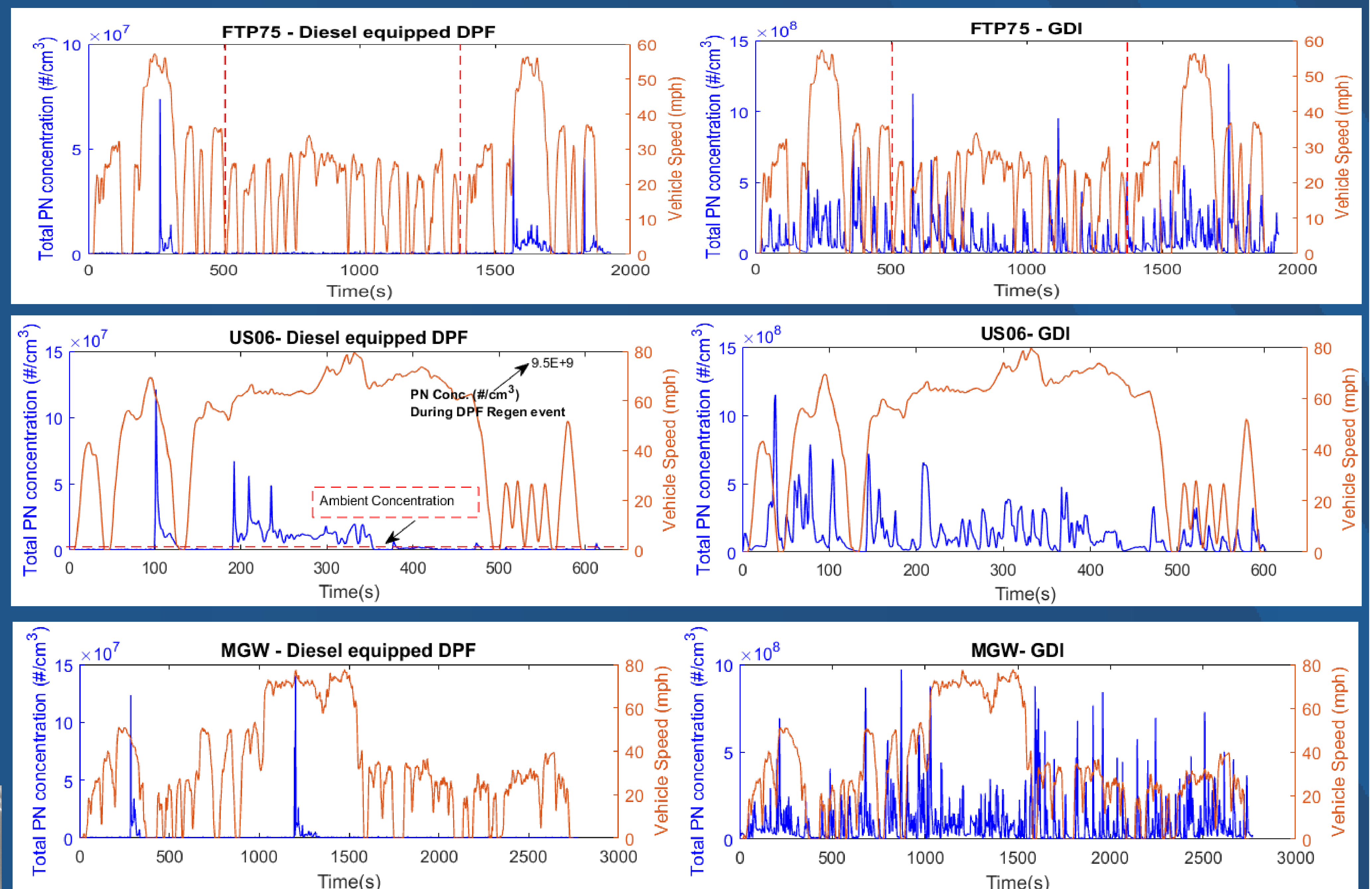
DIESEL PM MORPHOLOGY



GDI PM MORPHOLOGY



EXPERIMENTAL



CONCLUSION

- Medium load transient vehicle acceleration in the range of 30-40mph contributed most substantially to the elevated PN levels in GDI vehicles (about an order of magnitude higher).
- DPF equipped diesel vehicle was associated with peaks, only at $1\text{E}+8/\text{cm}^3$ for the acceleration event above 60mph vehicle speeds while for rest of all operating conditions, the DPF system trapped the particles effectively. This trend was observed consistently for both stabilized driving phase and aggressive transient phase, as well.
- GDI vehicle sample consisted of averaged particles with mean diameter at 52nm while for the DPF equipped diesel vehicle it was 10nm.
- Scanning Electron Microscopic (SEM) analysis of the sampled PM particles (Cu. based TEM grid placed on TSI SMPS electro classifier unit) were performed using JEOL JSM 7600F SEM. The analysis revealed certain unique morphological features in GDI samples. They were—needle like, transparent layered type (graphene like) and many agglomerates of sub 50nm nanoparticles. While in the diesel sample, the morphology observed were consistent with the findings from the well established literature of diesel soot.

