

CHARACTERISATION OF ULTRAFINE NON-EXHAUST EMISSIONS

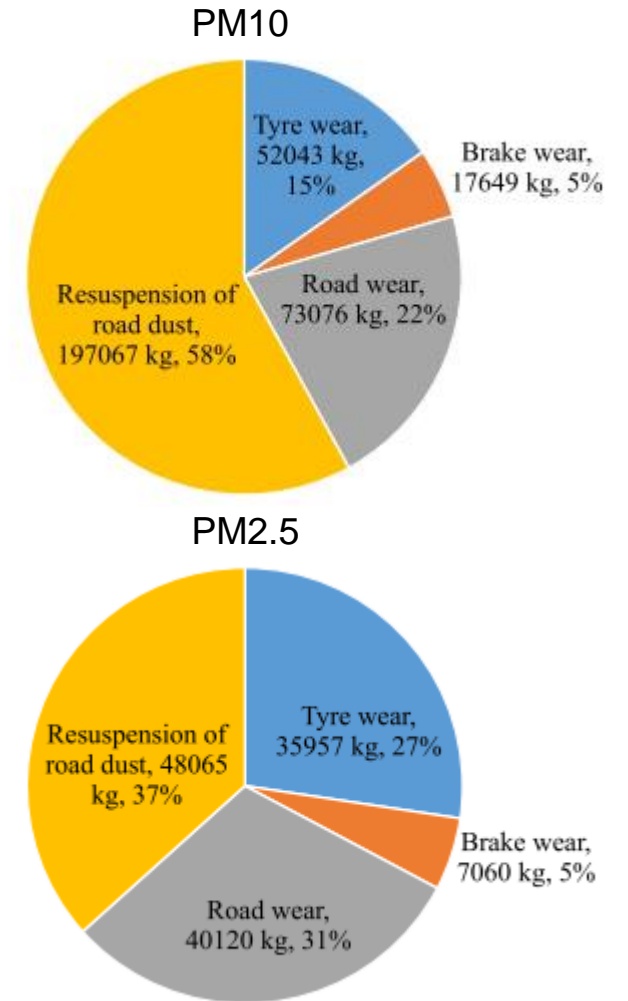
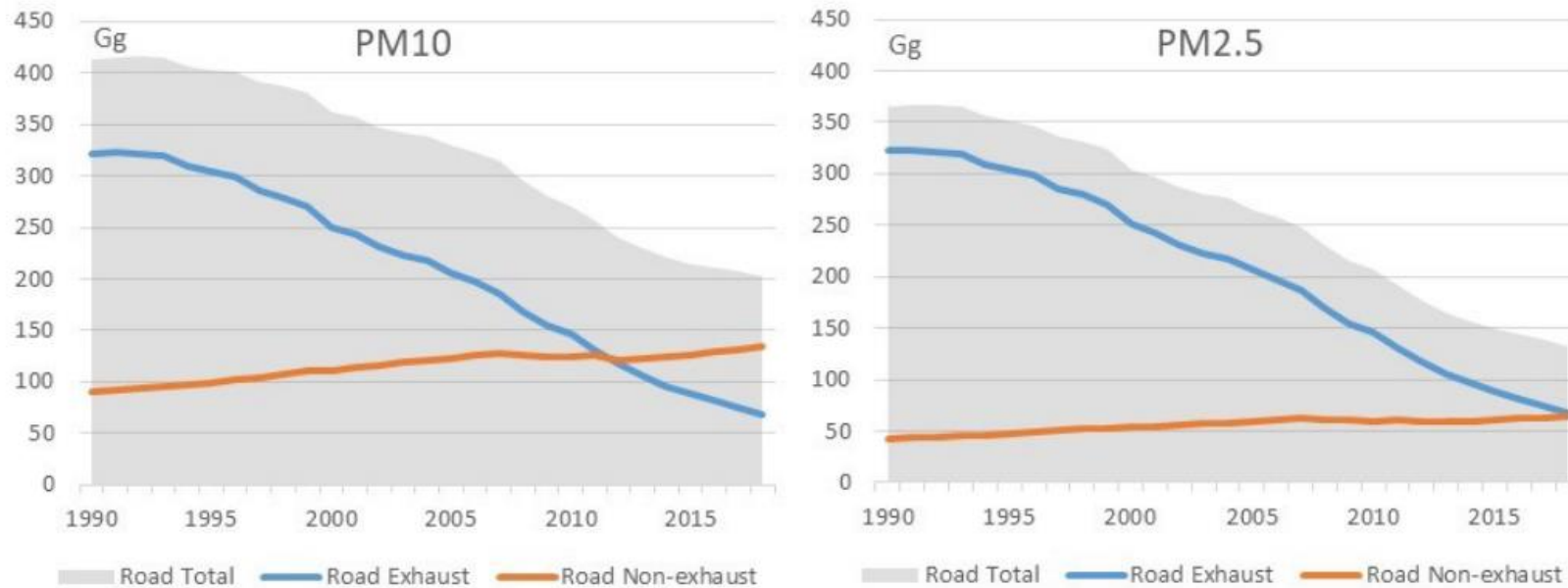
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Dr. Manuel Löber
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Institute of Combustion Technology
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Motivation

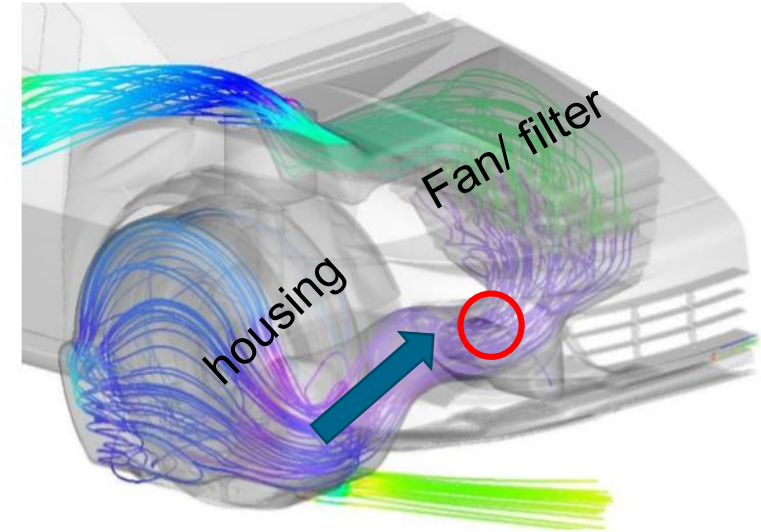
Figure 4: PM10 (left) and PM2.5 (right) emissions from road transport in EU28 (1990 to 2018)



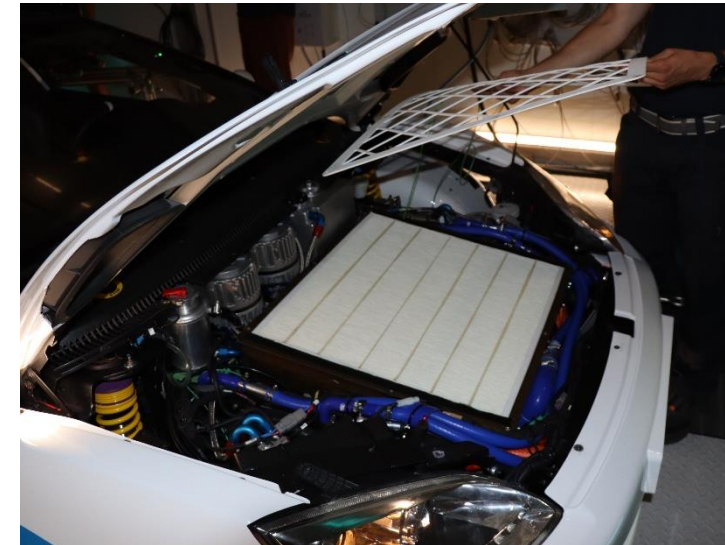
Eionet Report - ETC/ATNI 2020/5 .

Tire road wear emissions

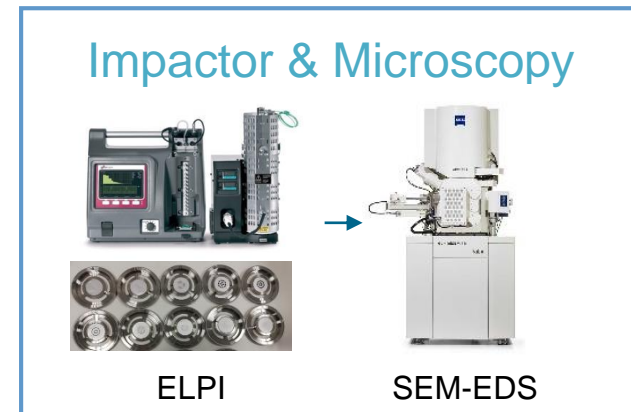
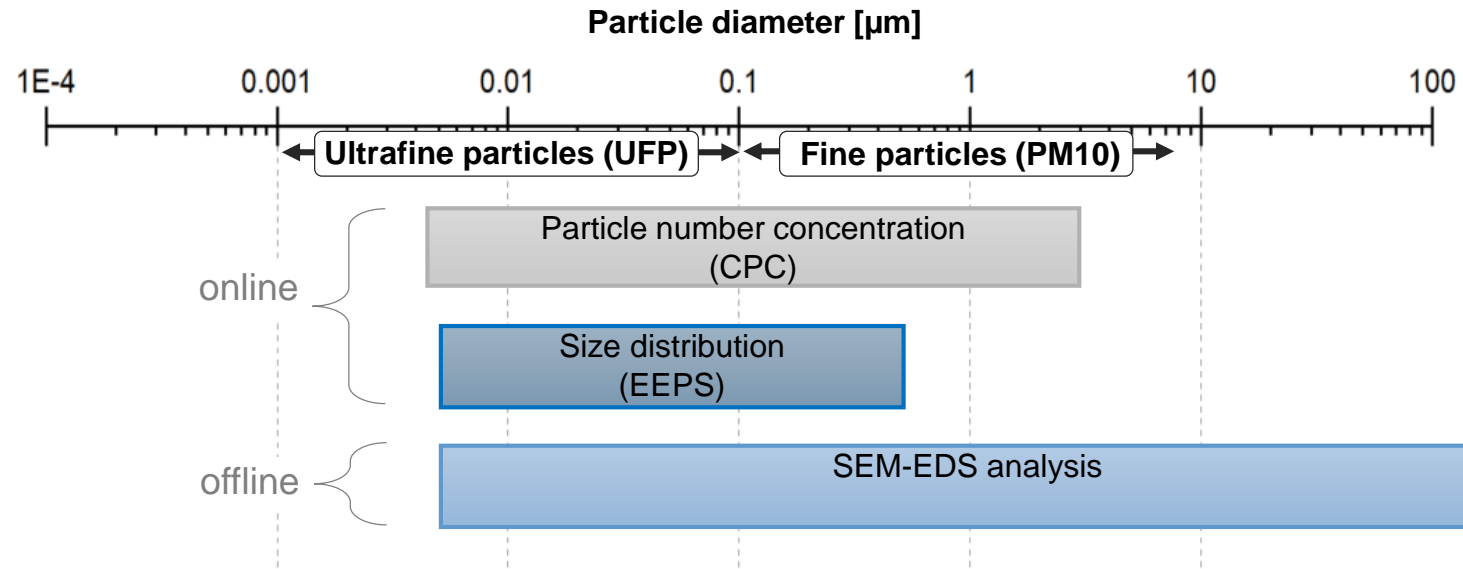
test facility (road)



chassis dynamometer

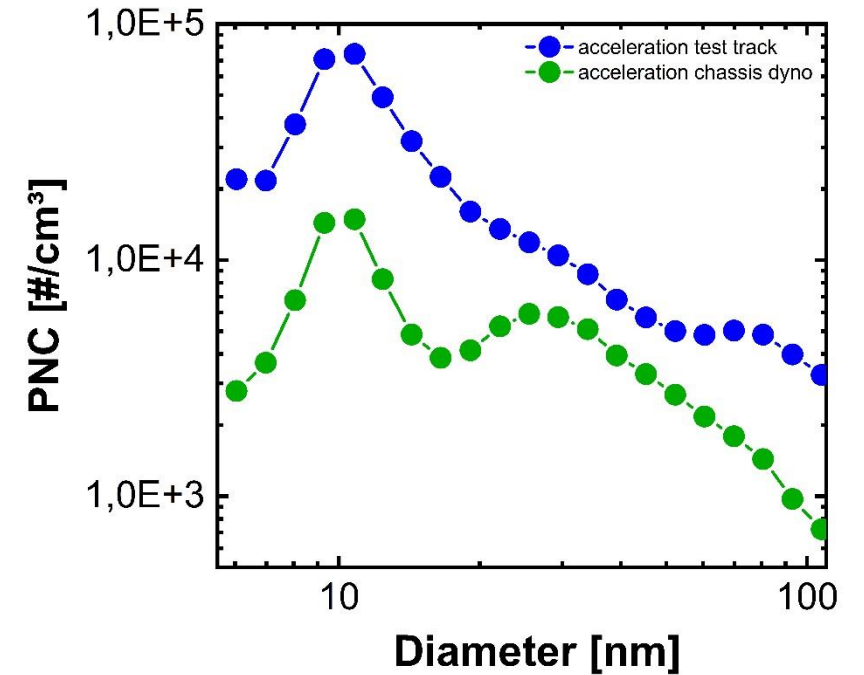
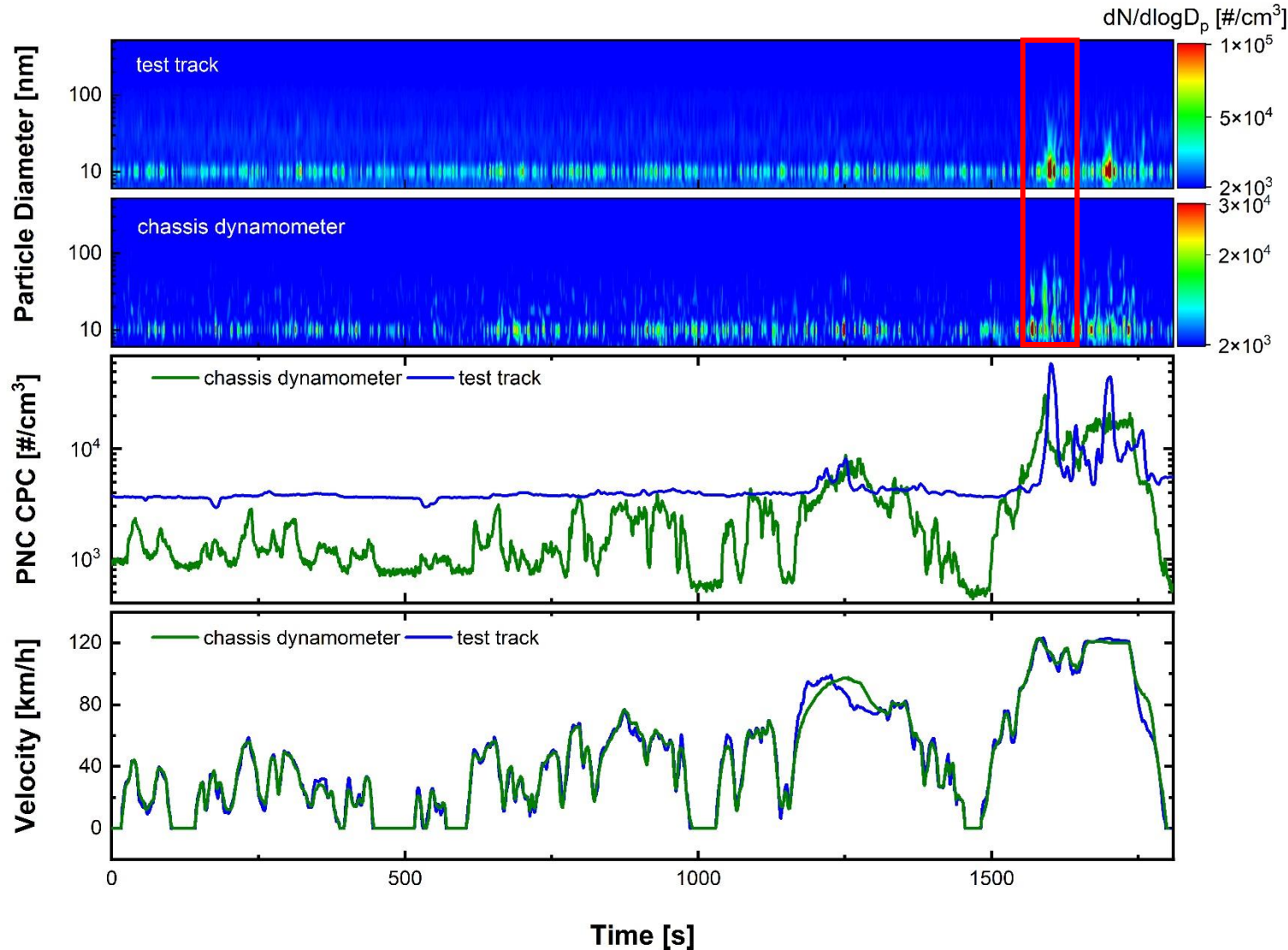


Instrumentation



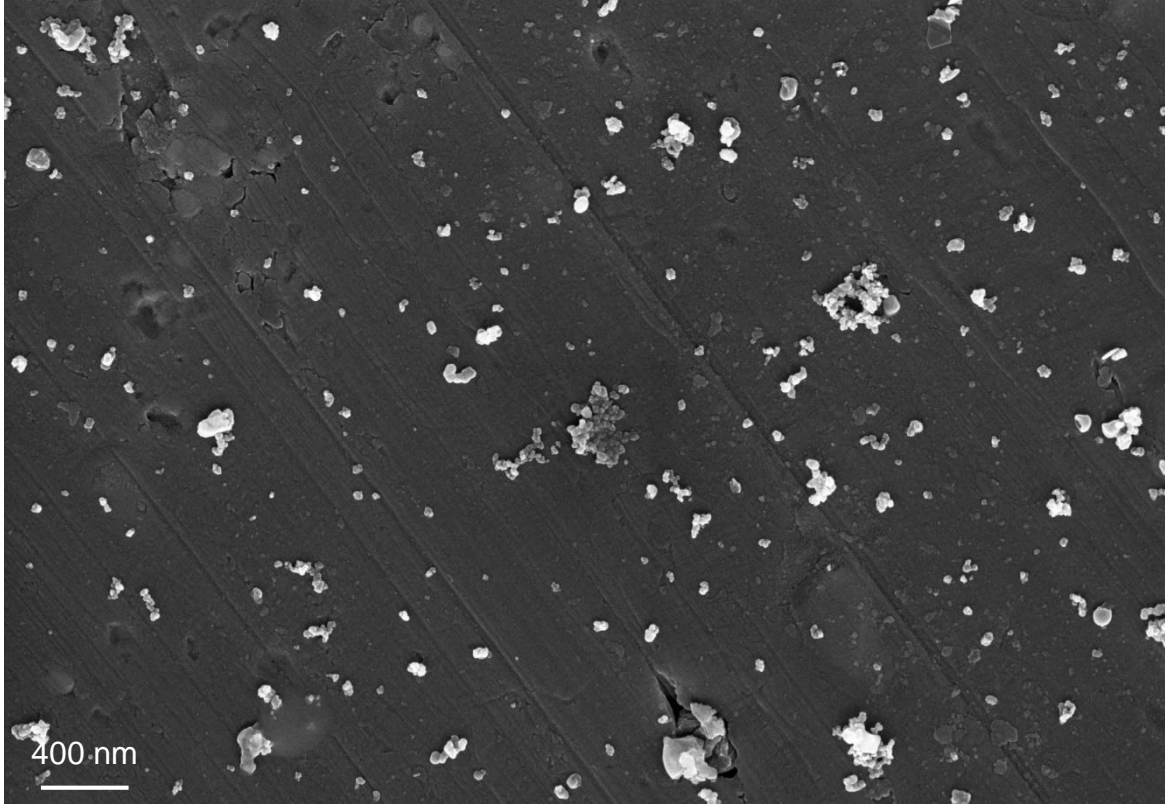
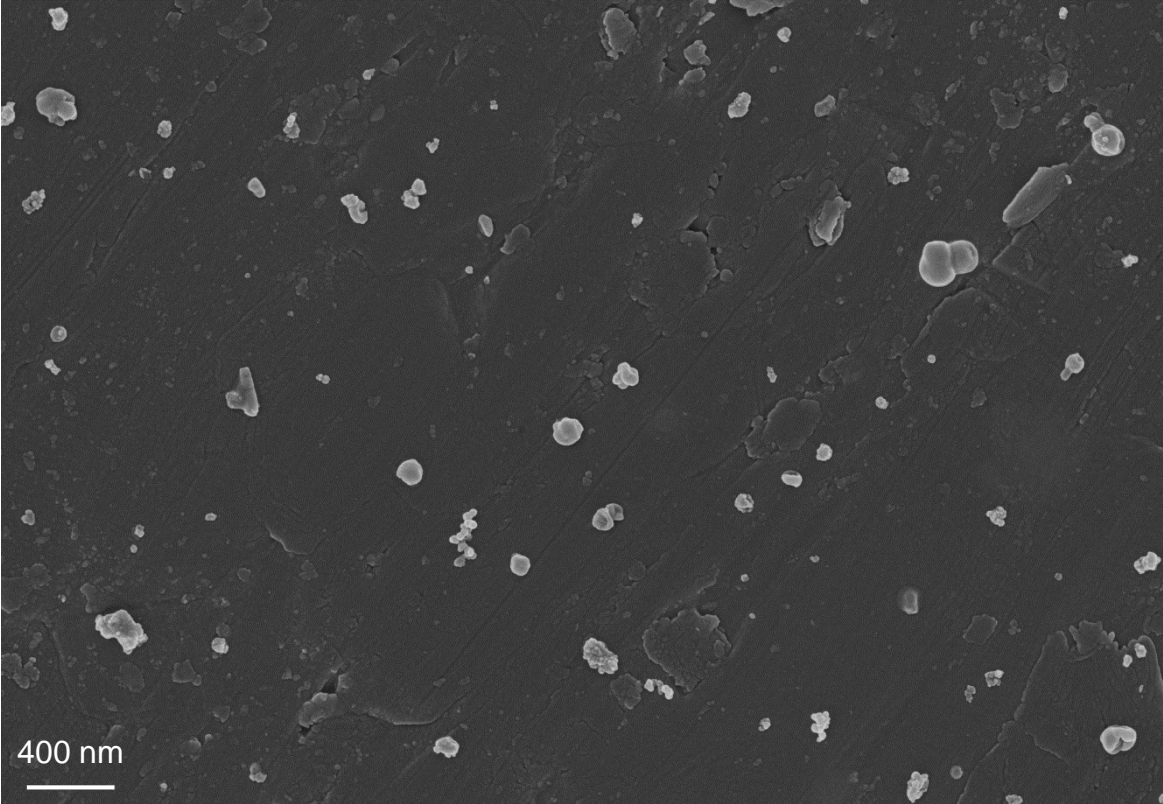
Tire road wear emissions

WLTC = Worldwide harmonized Light Duty Test Cycle

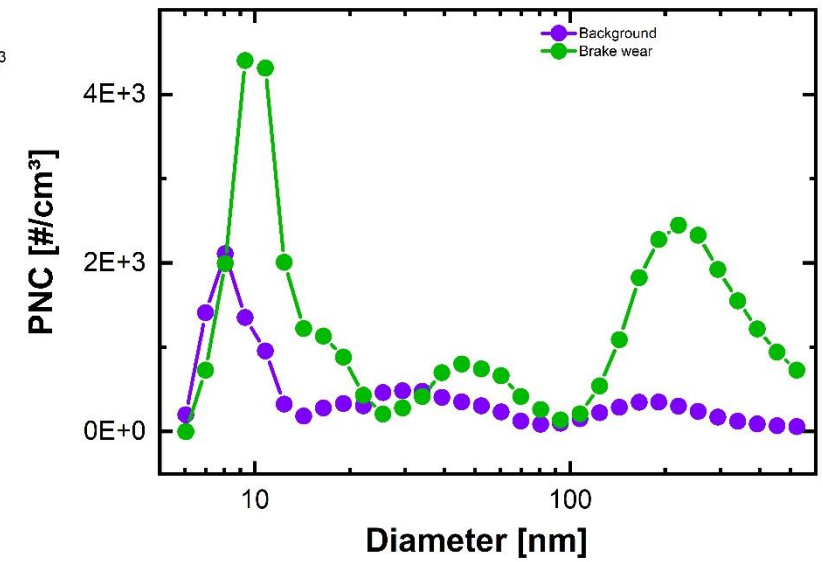
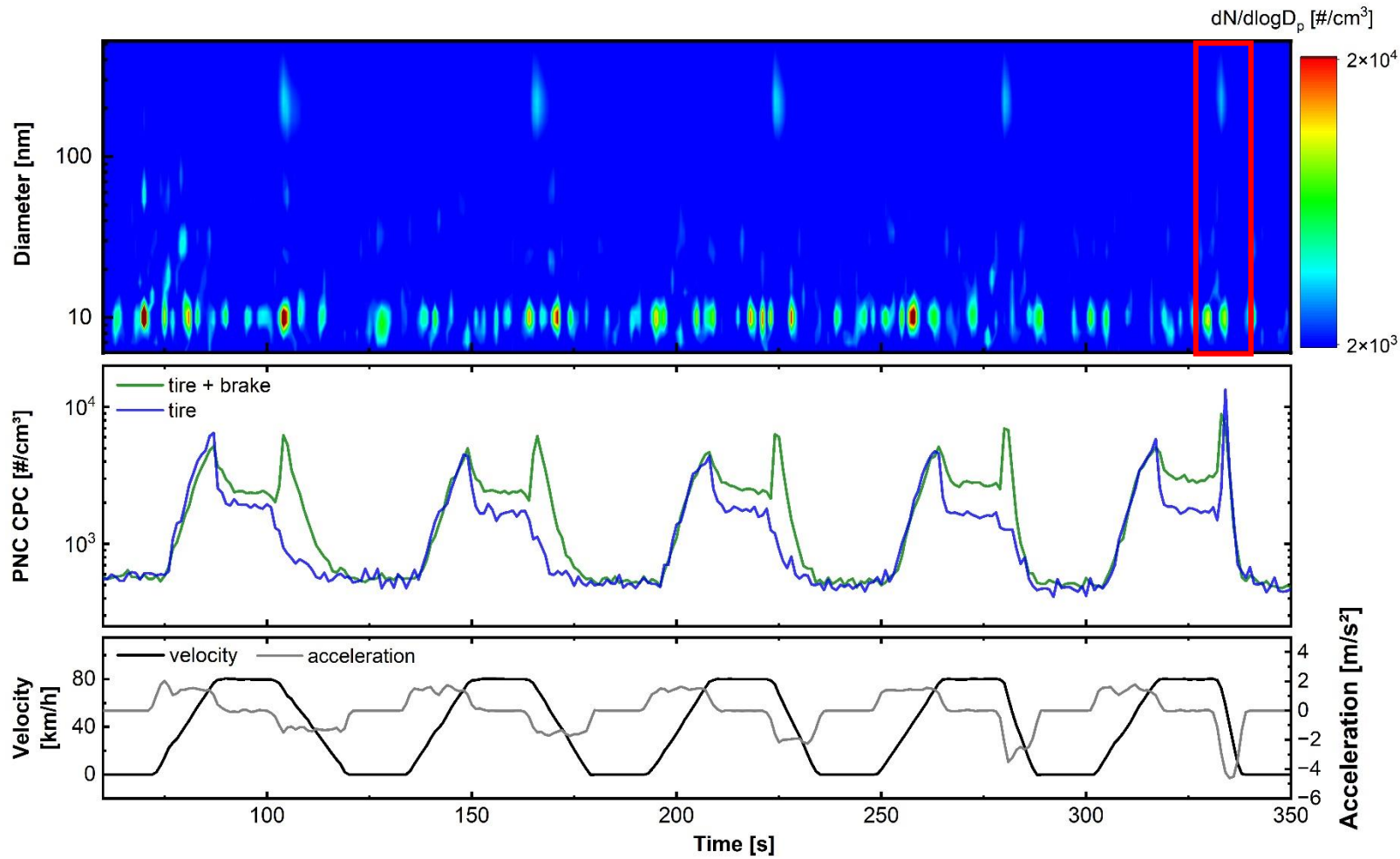


→ Publication coming soon!

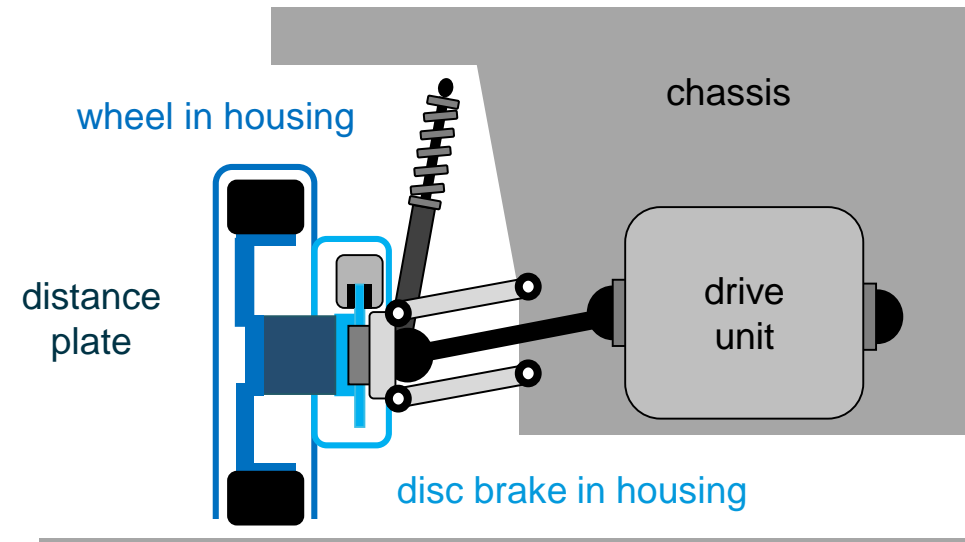
SEM



Brake wear emissions

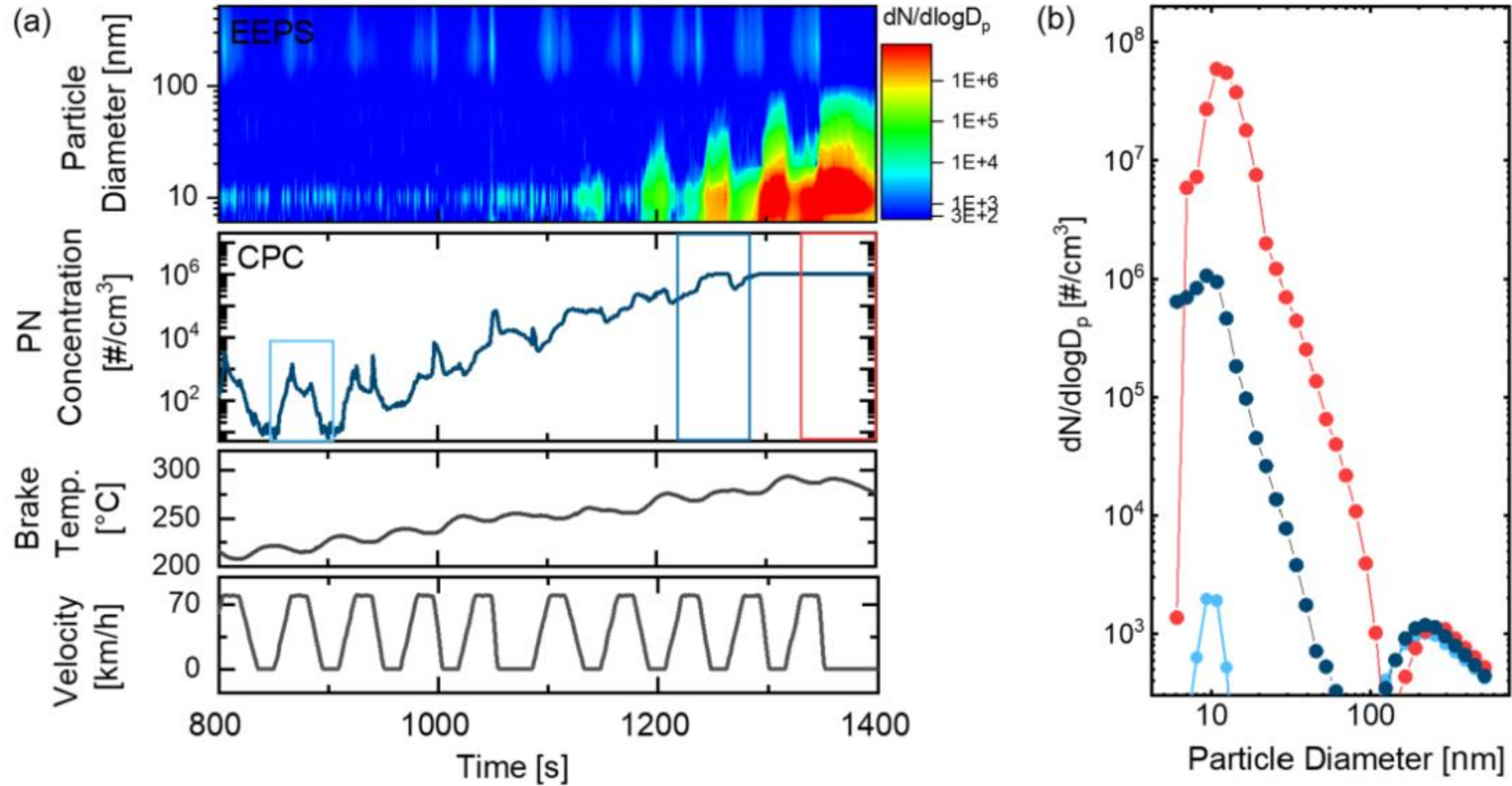


Brake wear emissions



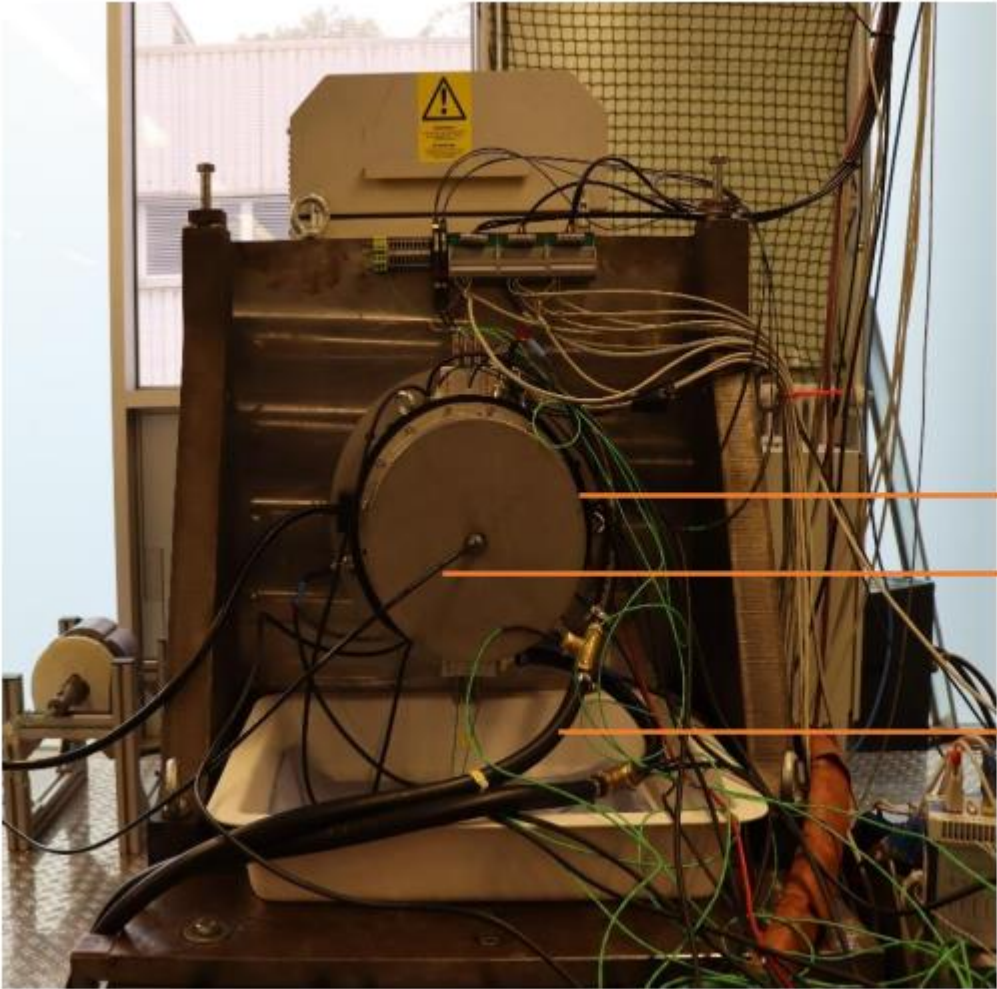
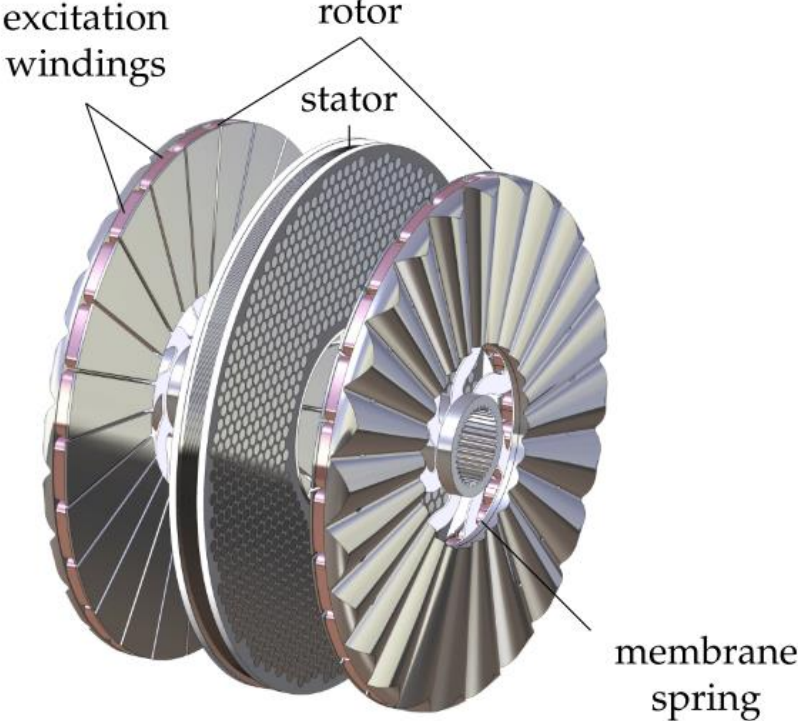
- Independent brake/tire wear sampling
- HEPA filtered air
- Different brakes
- Different test cycles

Brake wear emissions



Bondorf L, Köhler L, Grein T, Epple F, Philipps F, Aigner M, Schripp T (2023): Airborne Brake Wear Emissions from a Battery Electric Vehicle. Atmosphere 14, 488.

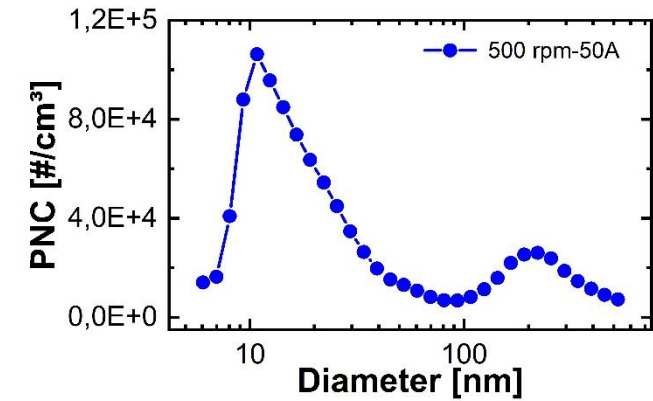
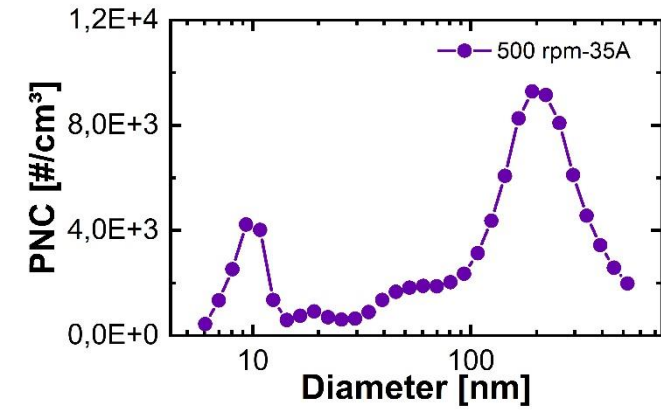
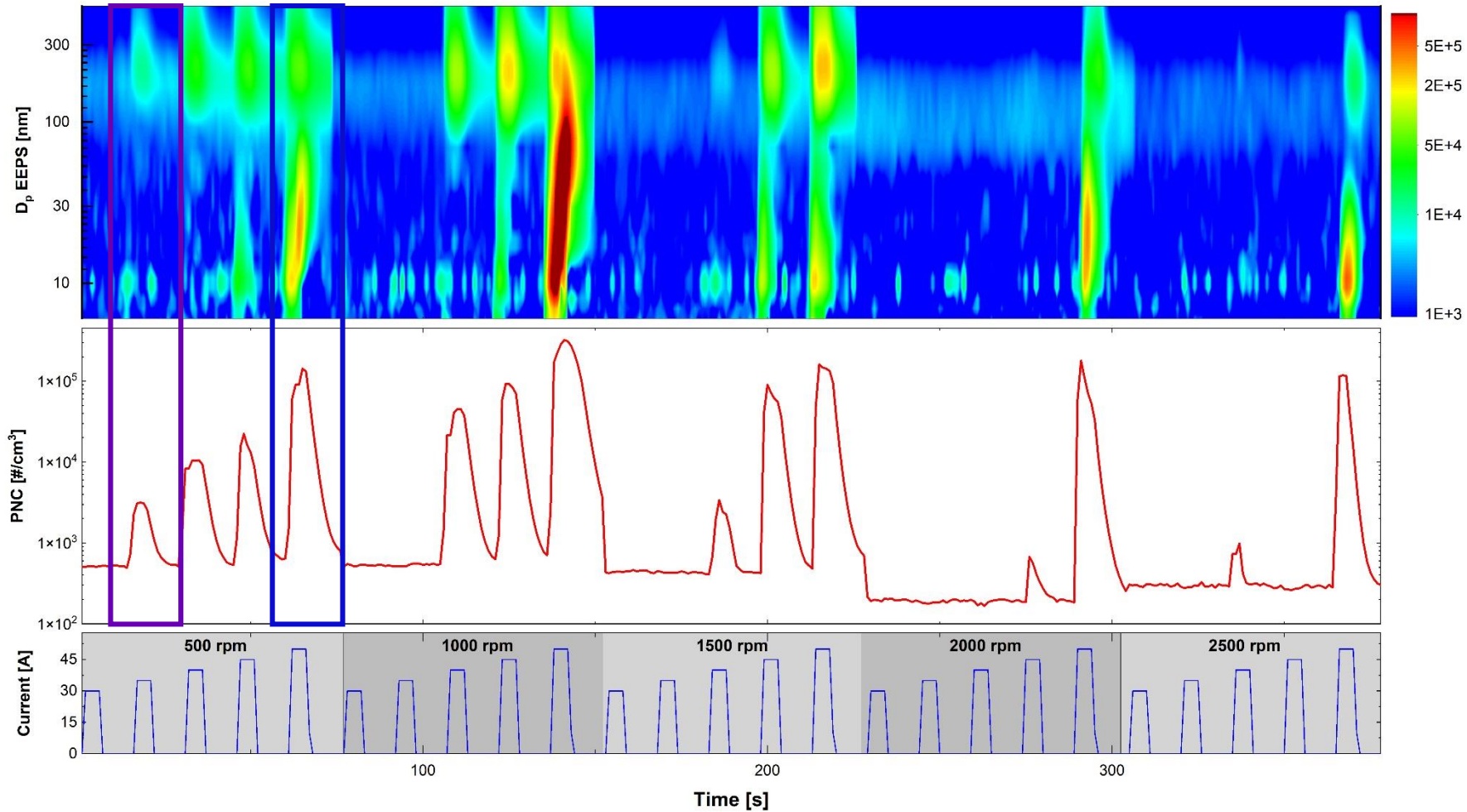
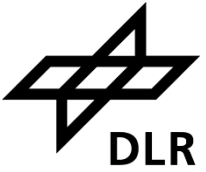
Hybrid brake emissions



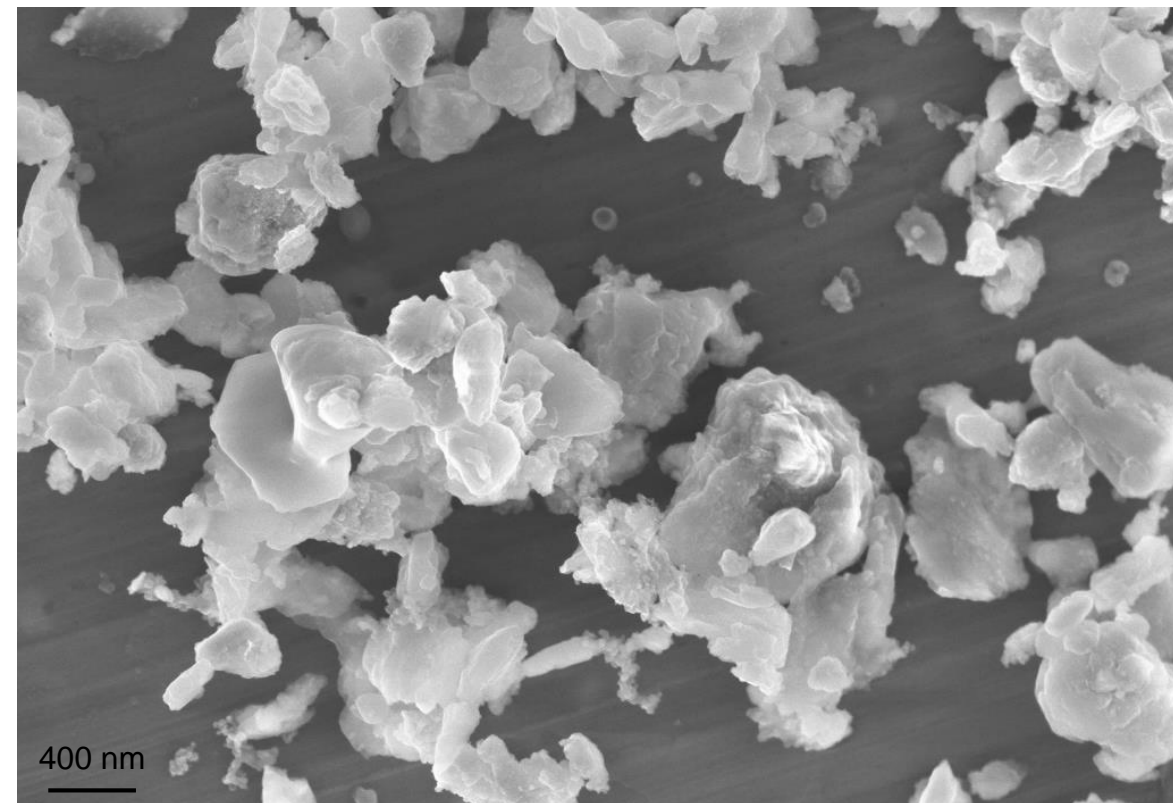
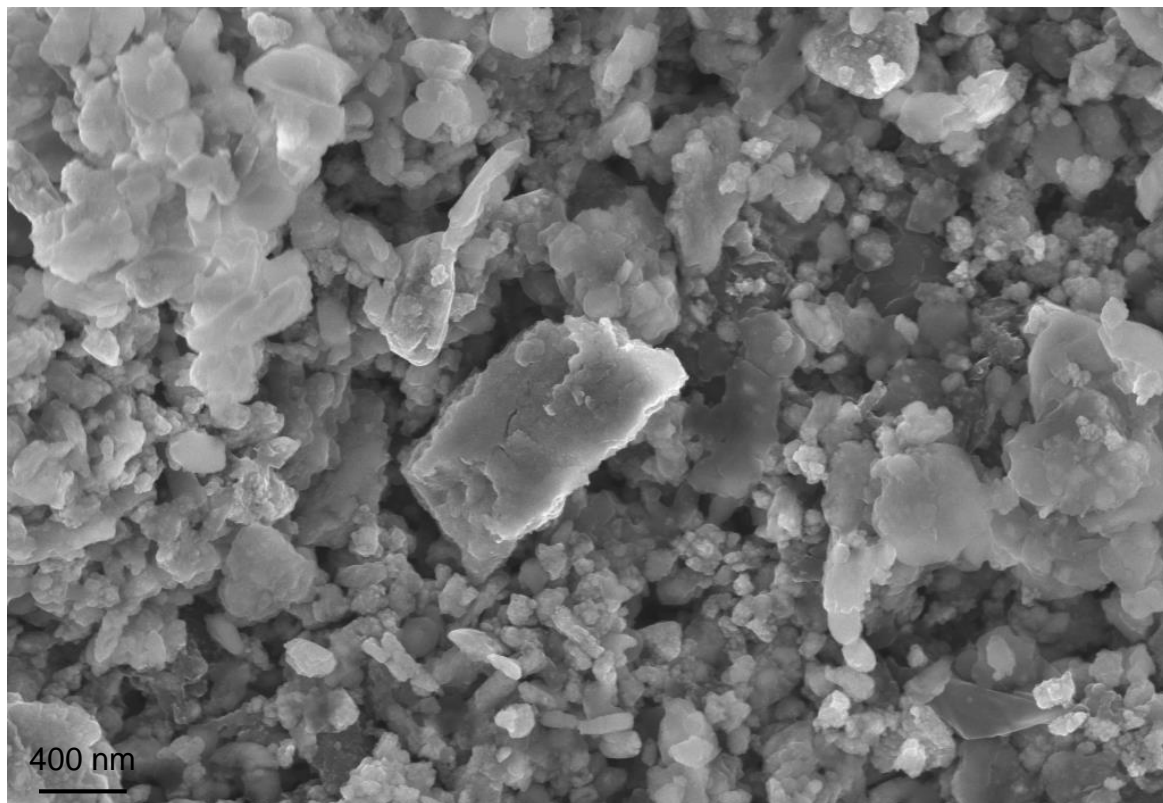
- Housing
- Air sampling
- Cooling system

Holtmann, C.; Köhler, C.; Weber, C.; Rinderknecht, F. The Hybrid Brake Model and Its Validation. *Electronics* **2023**, *12*, 2632.

Hybrid brake emissions



SEM

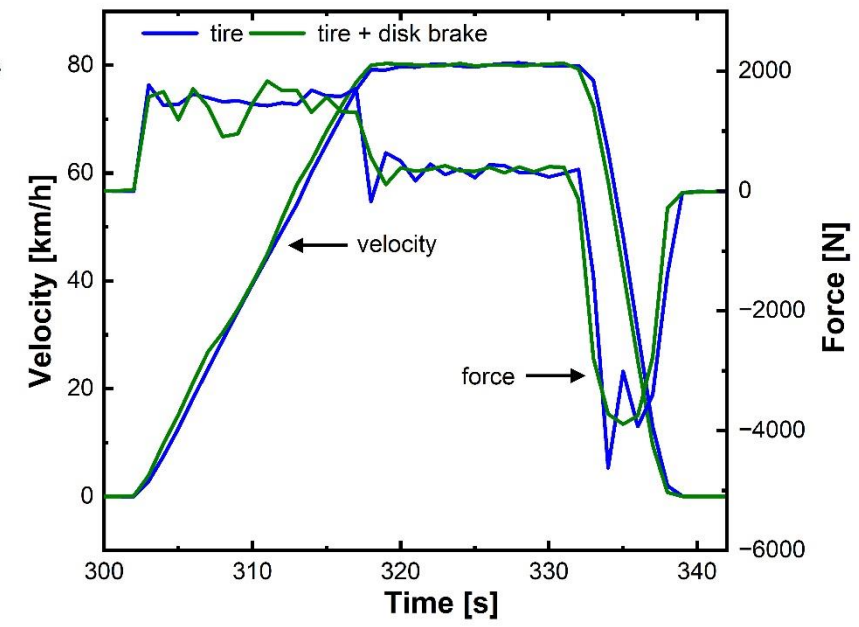
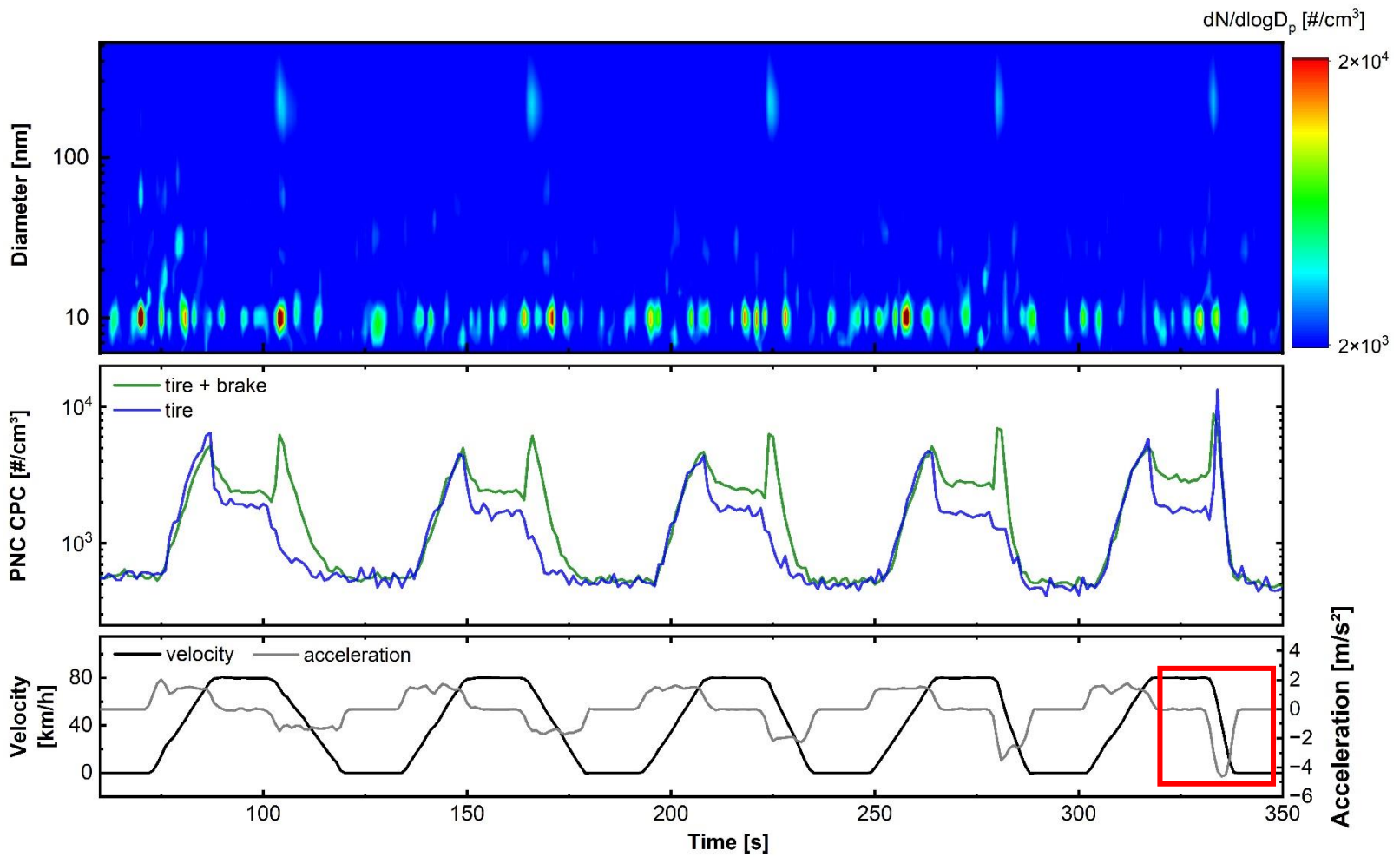


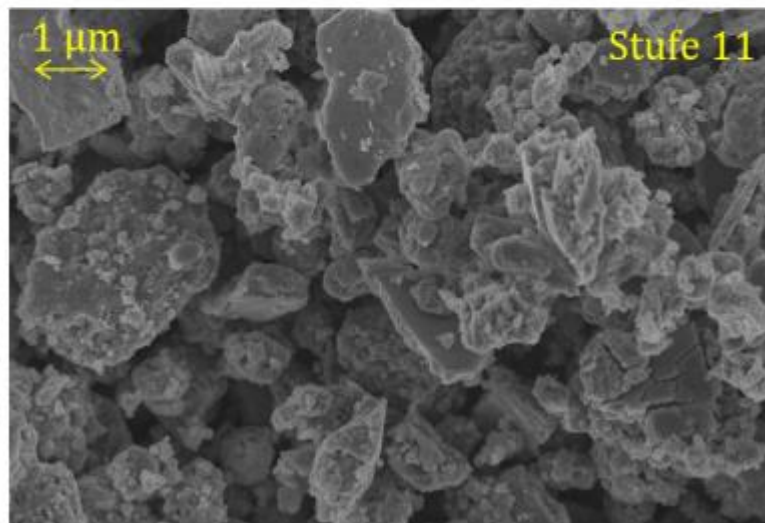
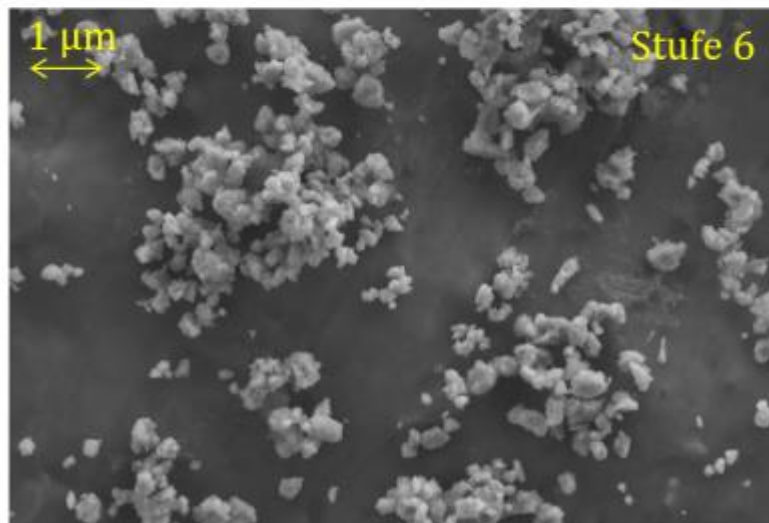
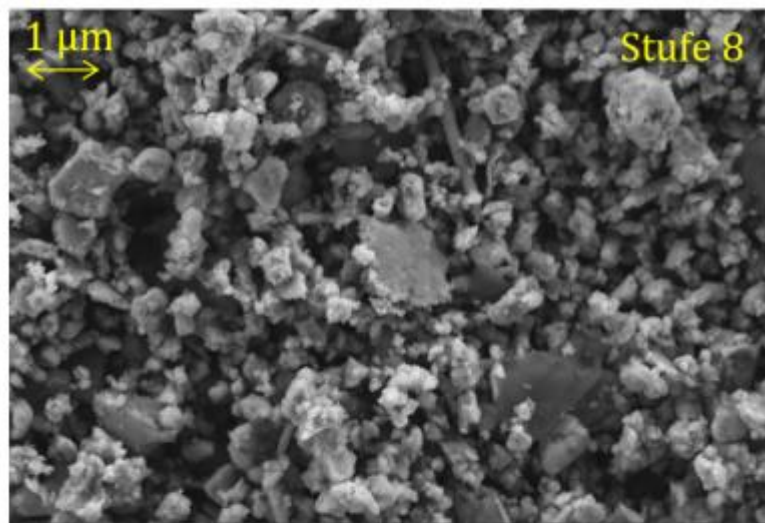
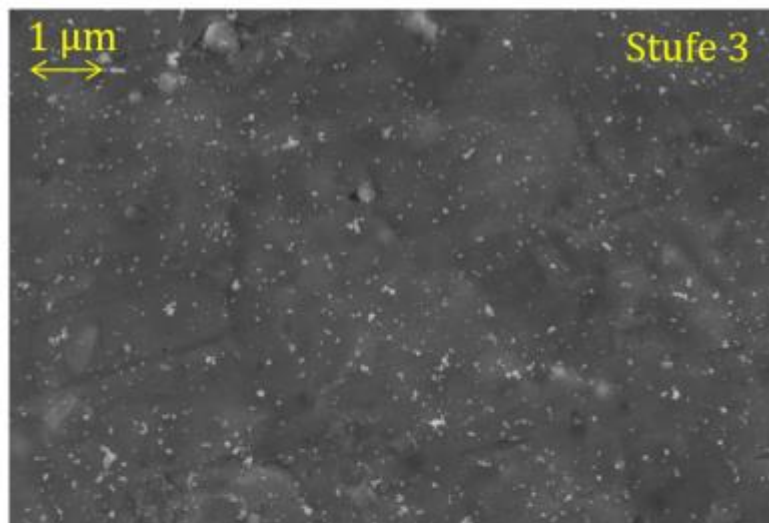
Summary



- Investigation of tire road wear particles
 - Comparable emissions tests on the chassis dynamometer/test facility
 - Particle diameters of around 10 nm, 30 nm and 80 nm
 - SEM reveals spherical particles
- Investigation of brake wear particles
 - Independent brake wear sampling
 - Predominant size mode around 200–300 nm
 - High UFP emissions around 10 nm at temperatures > 250 °C
- Investigation of the novel hybrid brake
 - Variation of current intensity and rotation speed
 - Two size modes at 10 nm and 200 nm
 - Platelets and elongated particle shapes

THANKS FOR YOUR ATTENTION!





SEM

