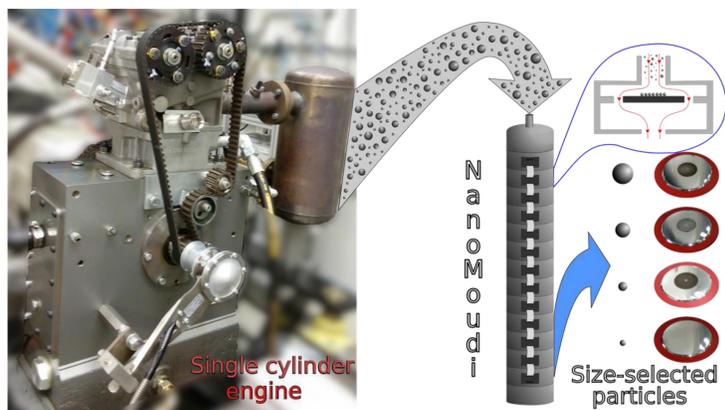


Size-selective sampling and chemical characterization of ultra-fine particulate matter emitted by a direct injection single cylinder gasoline engine

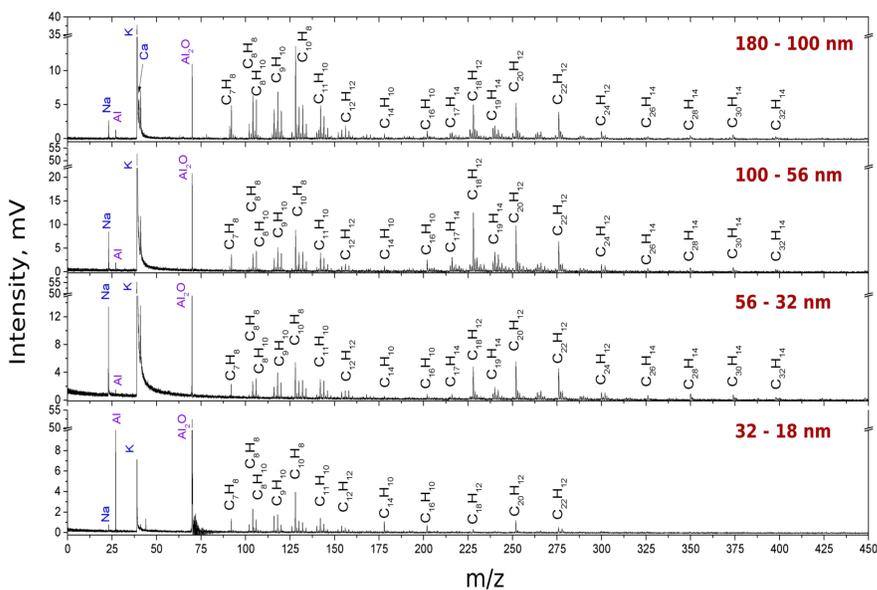
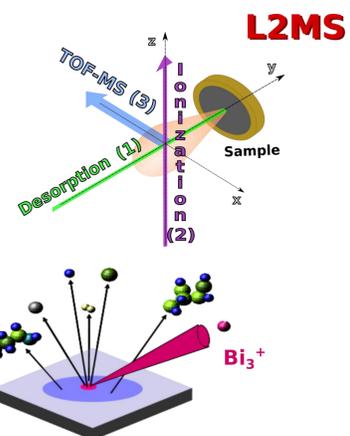
Context & objectives

- Particle emissions from on-road vehicles represent a significant societal concern due to their high toxicity and climate impact.
- There is a critical lack of certification procedures under real driving conditions and for the smallest particles, down to 10 nm.
- The goal of the H2020 PEMs4Nano project (www.pems4nano.eu) is the development of a measurement procedure down to 10 nm in real driving conditions.
- The development of such a procedure requires a deep understanding of emitted particles, in particular the size variation of the chemical composition.
- Chemical characterization of size-selected particles emitted by a direct injection single cylinder gasoline engine is presented.

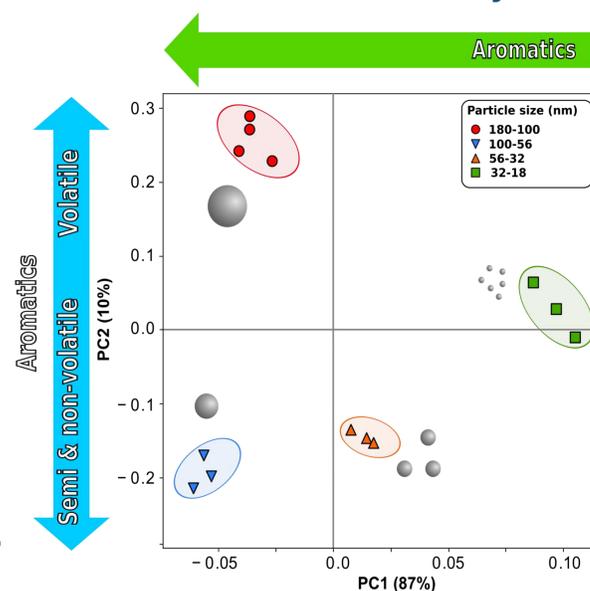


Experimental setup

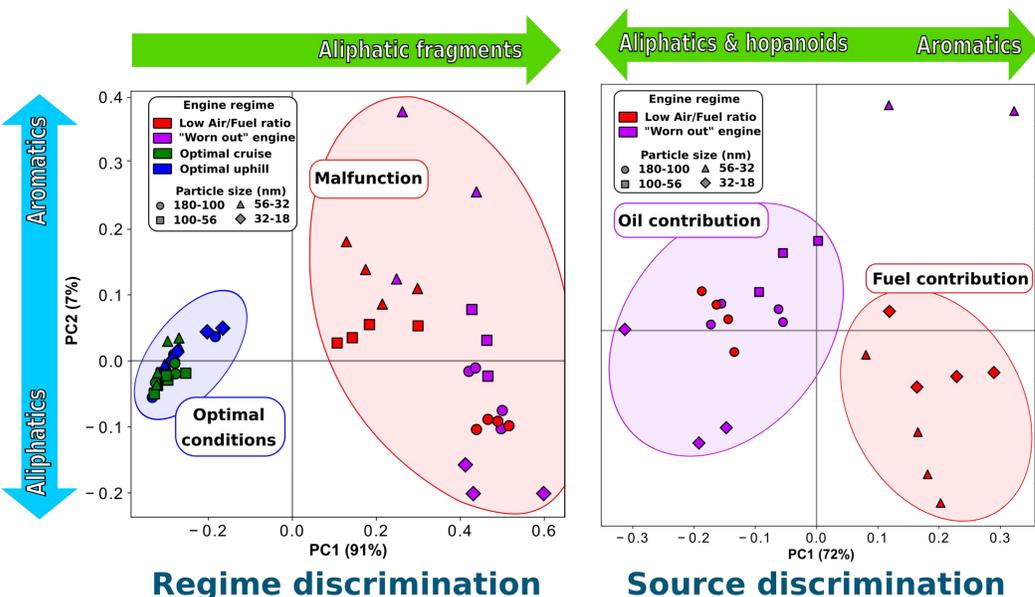
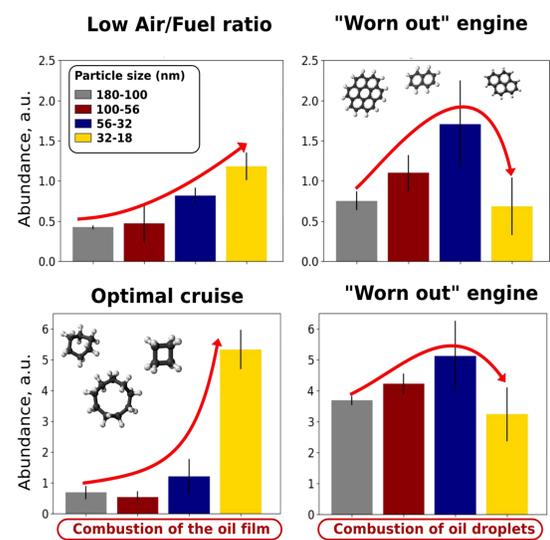
- Investigated particles (i.e. soot) were generated by a single cylinder engine operated in different regimes.
- Particles were sampled by a cascade impactor (NanoMoudi-II, TSI) enabling size-selective sampling.
- Chemical characterization was performed with a two-step laser mass spectrometer (L2MS) and a secondary ion mass spectrometer (SIMS, IONTOF) which allows us to obtain a detailed molecular analysis on chemical classes of critical interest^[1].



Discrimination by size



Size-dependent analysis



Conclusions

- The combination of L2MS, SIMS and PCA allows determination of detailed molecular level surface chemical composition of soot particles.
- The use of size-selective sampling allowed us to chemically characterize surface chemistry of particles down to 10 nm.
- Identification of key chemical markers, coupled with powerful PCA statistics, allowed discrimination of: **gasoline-specific** (PAHs, phenol, nitro-phenol), **lubricant-specific** (hopanes, steranes, cycloalkanes) and **engine-specific** species (metals and metal oxides).
- By identifying marker species, we have clearly discriminated particles by source, particle size and engine regime.

[1] A. Faccinetto et al. Progress toward the Quantitative Analysis of PAHs Adsorbed on Soot by Laser Desorption/Laser Ionization/Time-of-Flight Mass Spectrometry, Environmental Science and Technology 49, pp. 10510–10520, 2015.