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X-ray Based Techniques for Transportation Applications

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Transportation sector is facing a watershed moment: the need of reducing emission of greenhouse gases imposes radical changes in propulsion systems. Despite the run to powertrain electrification, this goal is far to be realized before 2050. Therefore, more and more attention will be paid worldwide to rich close-to-zero pollutant emissions from future road transportation vehicles.
Next future emission regulations will limit both exhaust and non-exhaust emissions (brake wear particles and Tire Road Wear Particles, etc.). This scenario imposes new challenges for development of advanced research methods capable to provide an insight on the inner structure pollutant species.

X-ray based techniques have been widely used in the recent past for the characterization of local phenomena occurring inside the fuel dense sprays emerging from high pressure injection systems for modern engine applications. Due to of the weak interaction
with the fluids, x-rays can penetrate fuel jets structures and provide spatially-resolved information along the propagation direction. Besides this frontier application x-ray based techniques are well recognized as the most effective solution to investigate the interaction of engine exhaust catalysts with single pollutant species and for detection of soot and its precursors in internal combustion engines. This work aims at providing an insight on the state of art and perspective of x-rays techniques for transportation sector. First, a brief description of the different measurement techniques will be provided. Then, a detail on the measurement methods and examples will be provided, with particular care to soft-x-rays application. Finally, the more appropriate solutions for future vehicle application such tyre and road wear particles analysis will be proposed.

Primary authors: MARCHITTO, Luca; HAMPAI, Dariush; DABAGOV, Sultan

Presenter: MARCHITTO, Luca

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