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Abstract

Modern Gasoline Direct Injection (GDI) engines offer increased power output, improved fuel economy and reduced CO_2 emissions. However, the increased particulate matter (PM) emission level still remains a challenging task. Understanding PM features such as morphological and microstructural parameters through transmission electron microscopy can provide information about their formation, filtration and soot oxidation processes in the gasoline particulate filters and their impact on human health. This research article characterises PM emitted from a 2L 4-cylinder GDI engine at two injection timings: i) ECU settings which produces PM with high volatile content and ii) advanced injection timing to increase soot formation rate. Primary particle size distributions formed by volatile nature PM, present a higher standard deviation than for the sooty PM, while the former ones presented higher fractal dimension. In addition, five different methods of est*i*mating PM fractal dimension reported in the GDI literature have also been compared and it was concluded that the arising trends were in agreement. The effect of high percentages of exhaust gas recirculation (EGR) and reformate gas combustion on PM characteristics have been analysed. EGR does not have a significant effect in PM morphology. On the other hand, reformate combustion reduces the size of the primary particle and the agglomerates as well as increasing the fractal dimension.

Keywords: Particulate matter, fuel reforming, soot morphology, Gasoline Direct Injection, Transmission Electron Microscope

DEFINITIONS, ACRONYMS, ABBREVIATIONS

A	Projected area.
A_p	Primary particle area
α	Exponential Factor
bTDC	Before Top Dead Centre