The common thread between fuel identity, soot structure and oxidation reactivity

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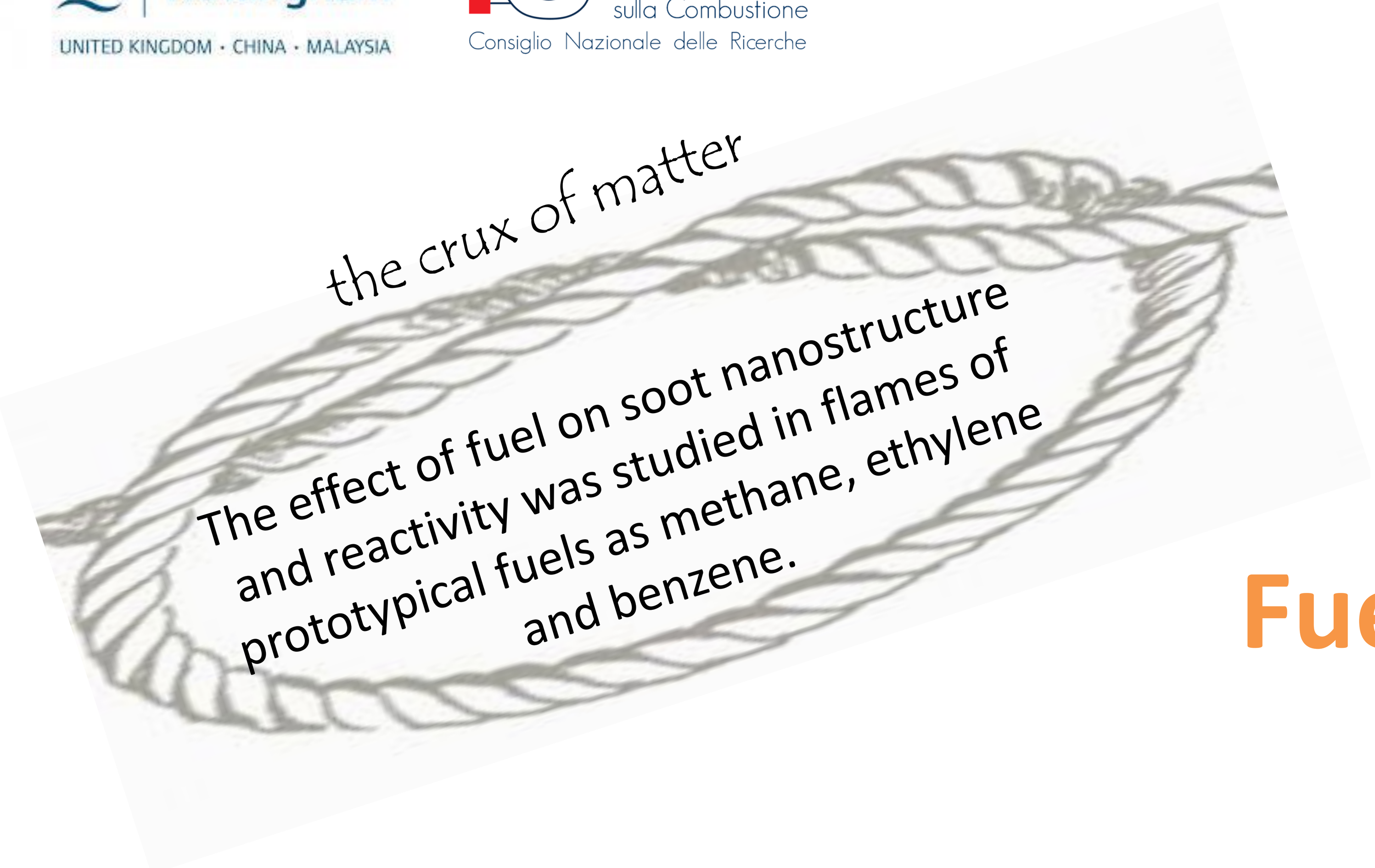
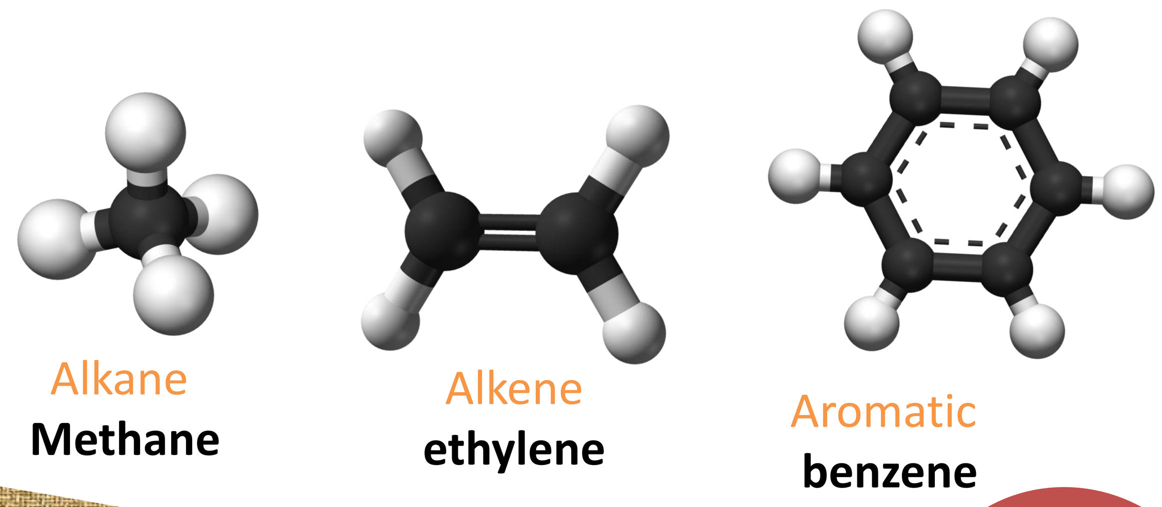
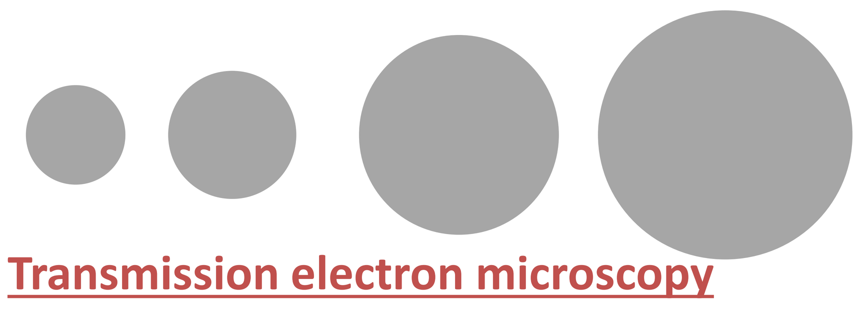


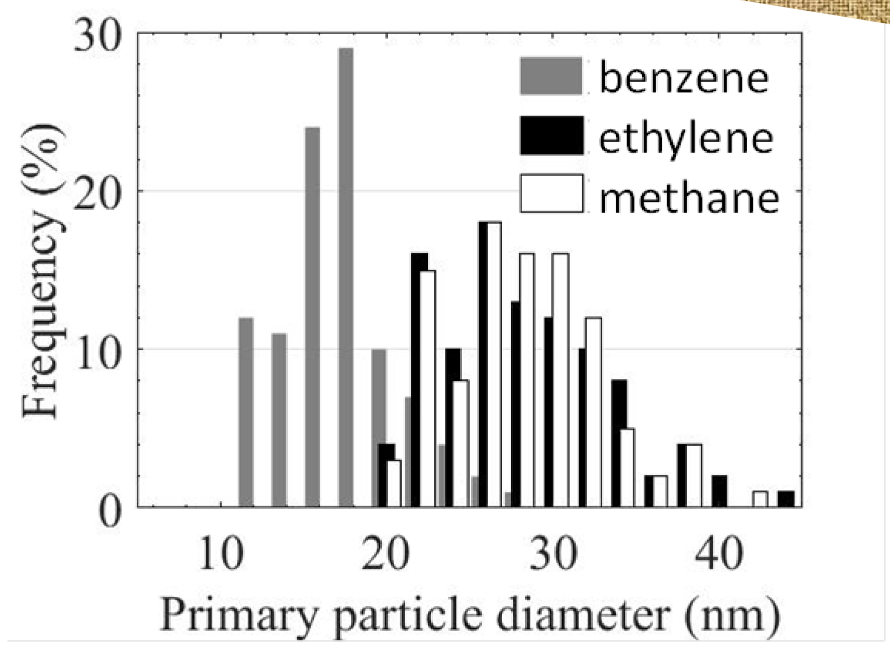
Fuel identity

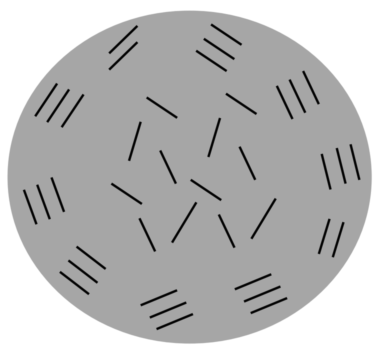


Soot nanostructure

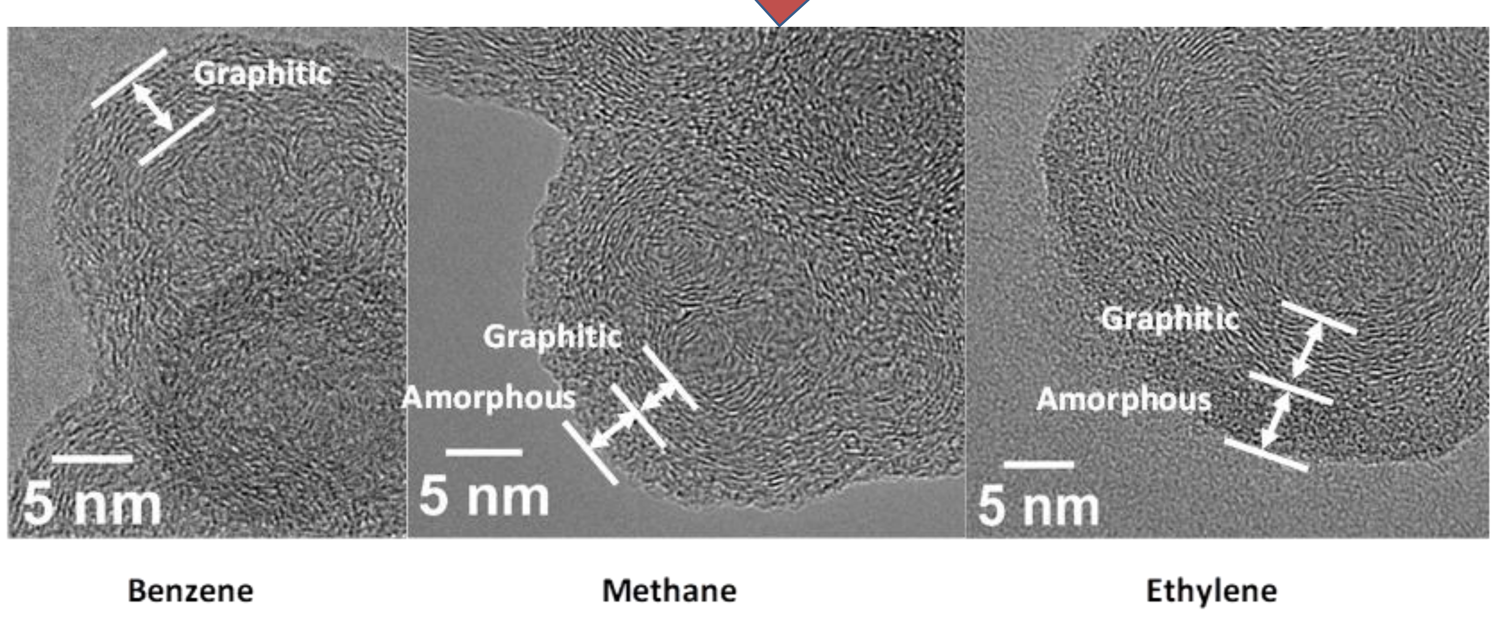


Transmission electron microscopy TEM
Particle size
Surface-area-to-volume ratio

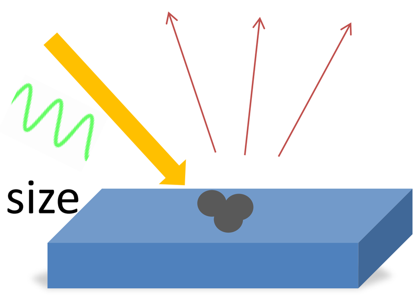


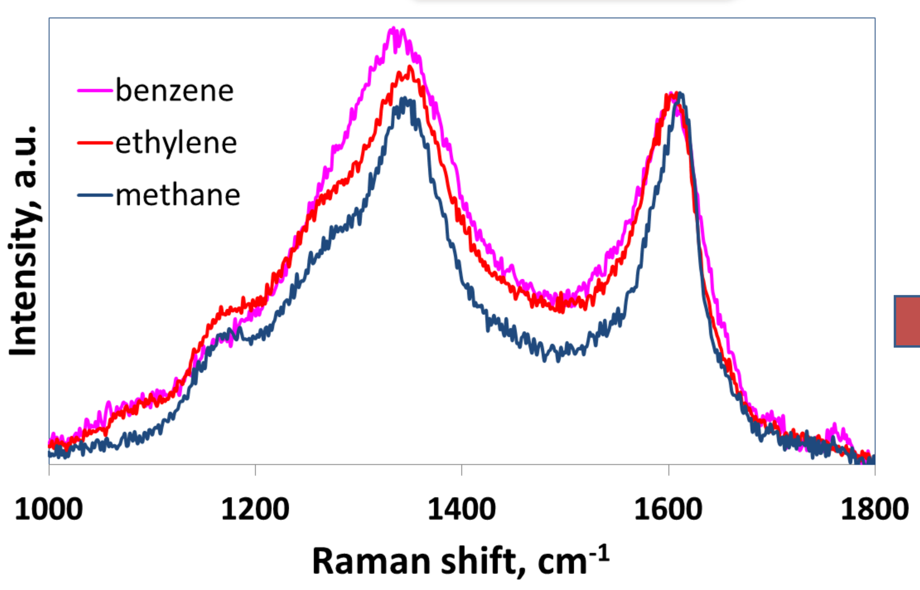


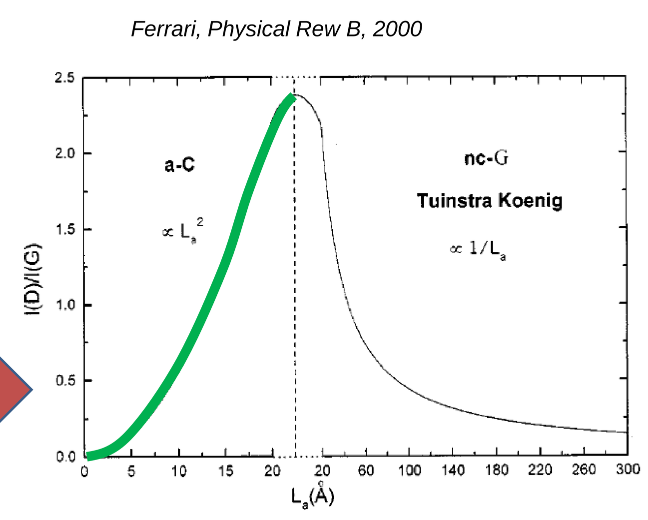
HR-TEM
Nanostructure
Amorphous/Graphitic ratio



RAMAN
Aromatic layer size

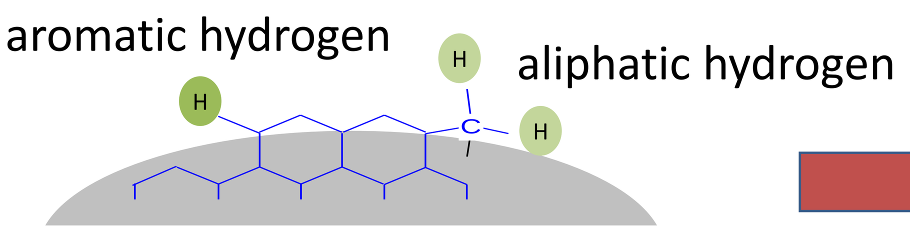


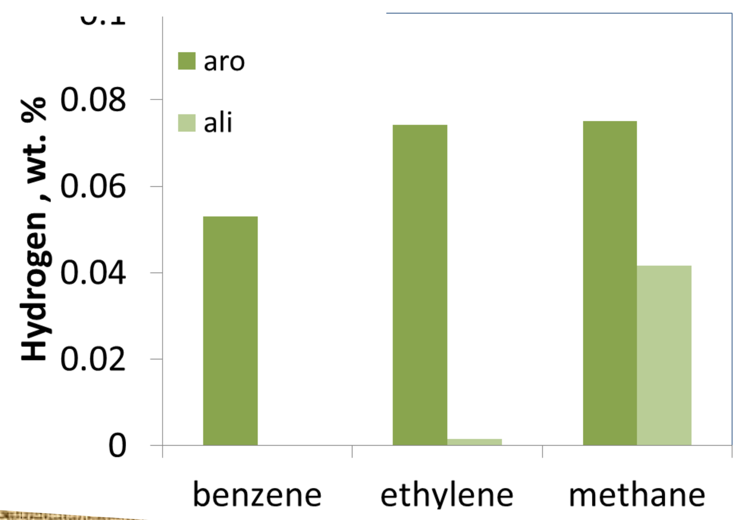




$$L_A^2(nm^2) = 5.4*10^{-2}*E_L^4(eV^4)*\frac{I(D)}{I(G)}$$

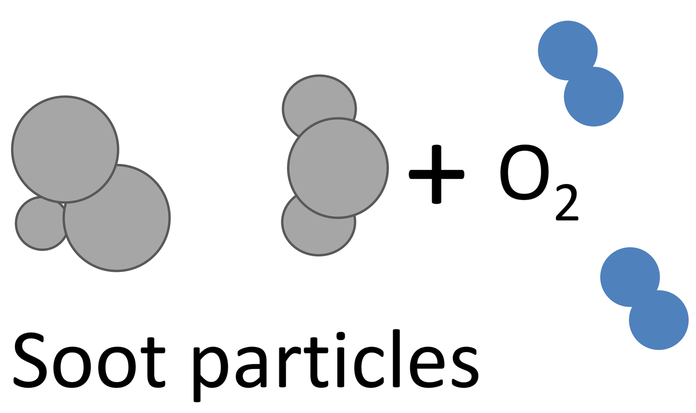
FT-IR spectroscopy
Functional groups
Hydrogen quality

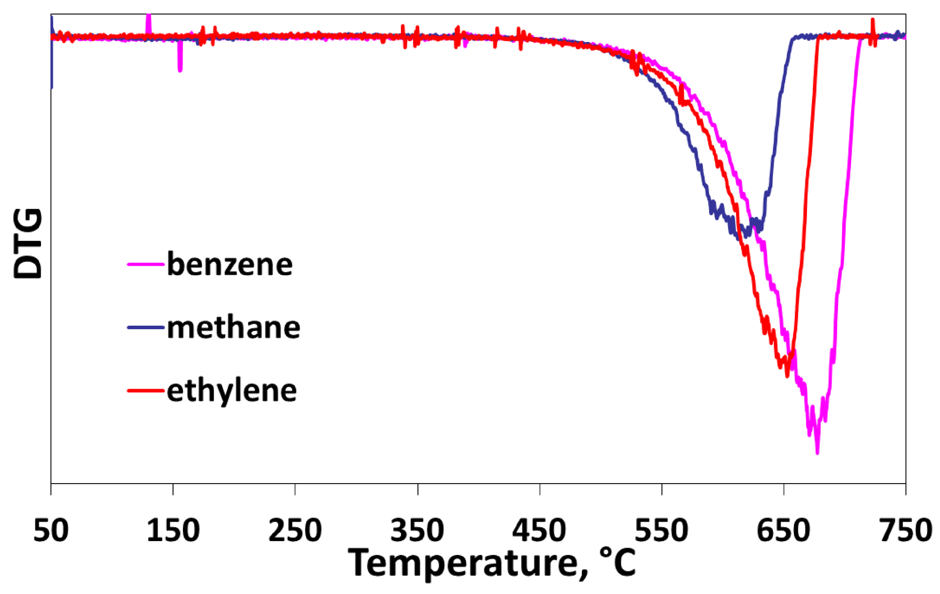


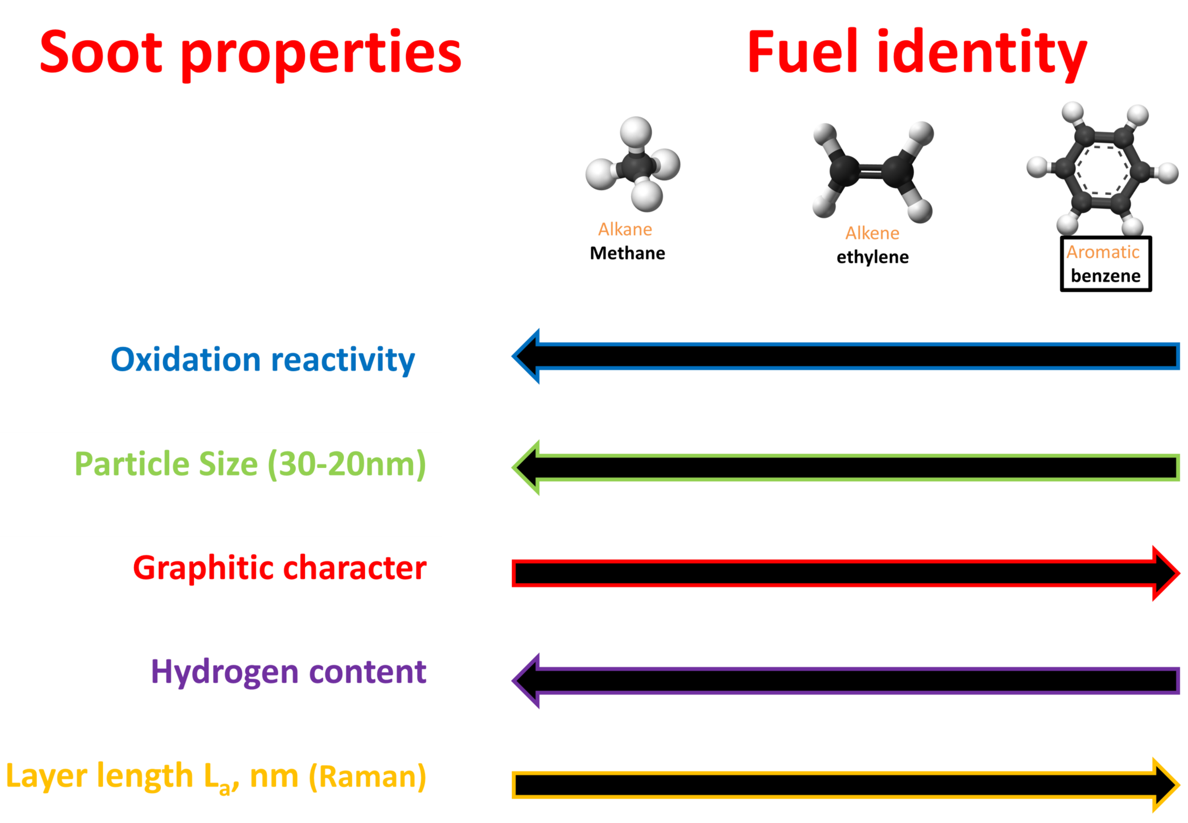


Soot oxidation reactivity

Thermogravimetric analysis TGA
Max oxidation temperature→ Soot oxidation reactivity







The oxidation reactivity of soot sampled from premixed methane, ethylene and benzene flames burning in similar temperature conditions, was studied by:

- Thermogravimetric analysis (TGA): Methane soot showed to be the most reactive among the samples. Benzene soot appeared the more resistant to oxidation.
- TEM analysis: Smaller size of benzene soot particles and consequent higher surface area. Thicker graphitic shell observed for benzene soot
- FT-IR: Higher hydrogen content for methane soot
- Raman spectroscopy: higher aromatic layer length for benzene soot

These inferences confirm that soot oxidation reactivity is independent on soot particle size higher for soot having higher hydrogen, lower graphitic character and extension of aromatic layer, etc. in turn dependent on the fuel identity, namely the hydrocarbon insaturation.

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Acknowledgements

This work was supported by the Royal Society International Exchanges Scheme [award number IES\R3\170088], and the Engineering and Physical Sciences Research Council through the scholarship provided by EPSRC Thematic Program in Low-Dimensional Materials and Interfaces for Sebastian Pfau [grant number EP/N50970X/1]. The authors thank the Nanoscale and Microscale Research Centre (nmRC) for providing access to instrumentation and Dr. Michael W. Fay for technical assistance.v