Exploring the morphological and structural attributes of Carbon nanoparticles used as soot replica in combustion studies: A Comprehensive 2D/3D Analysis

Andrea Pacino, Antonino La Rocca, Michael Fay, Alasdair Cairns

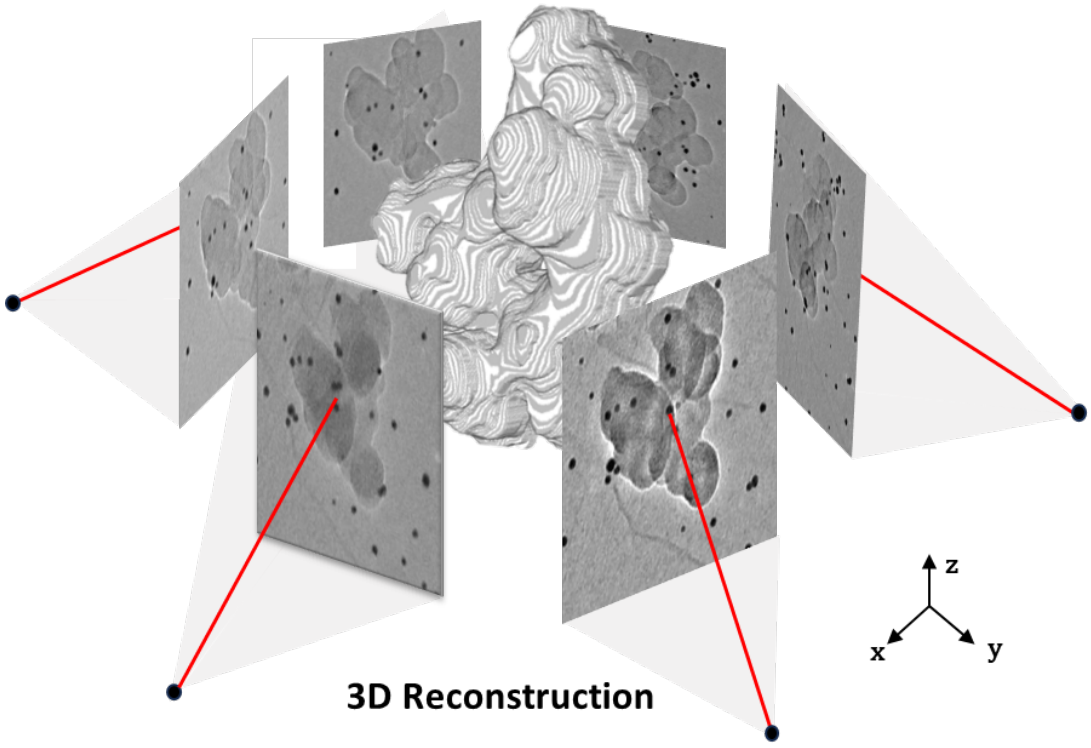
University of Nottingham, University Park, Nottingham, United Kingdom
andrea.pacino2@nottingham.ac.uk

The proposed work focuses on a comprehensive characterization of 3 commercially available carbon black samples typically used in combustion studies. Particle sizes were determined using transmission electron microscopy. A novel high-throughput Electron tomography was used to create 3D volume reconstructions of carbon particles, while the microstructure was investigated by fringes analysis.

A JEOL 2100F TEM microscope with a Gatan Orius CCD camera, based in the Nanoscale and Microscale Research Center (nmRC) at the University of Nottingham was used to perform the imaging. The 3D reconstruction is enabled by a series of 2D images of the particle from different angles [1]

All carbon blacks were found in their agglomeration form on TEM grid, however, monodisperse carbon aggregates of 200 nm in size also occur as distinct entities. At the primary particles size level, Vulcan showed a more diverse nanostructure and more graphitic character, with particles ranging from 10 to 60 nm in diameter. Monarch and Mogul showed instead a comparable morphology in the 10 - 40 nm range, with a mean primary particles size 48% smaller than Vulcan.

Three-dimensional volume reconstructions of carbon aggregates revealed small 3D structures in the Monarch and Mogul samples, while the Vulcan particles were noticeably 2D, with just a single primary particle thick in the z-direction. A lower surface-to-volume ratio suggests a limited tendency to oxidation for this sample.



References

[1] HAFFNER-STATON, E., LA ROCCA, A. and FAY, M.W. (2018), Progress towards a methodology for high throughput 3D reconstruction of soot nanoparticles via electron tomography. Journal of Microscopy, 270: 272-289. https://doi.org/10.1111/jmi.12680