

Combustion-generated carbonaceous urban atmospheric UFPs: Fuel optimisation in transport and decentralized electricity economies to minimise their production and impact

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34% carbonaceous ultrafine particles (UFPs) in the atmosphere come from road transport [1]. Their toxicity generally increases as the particle size decreases. They are found in urban atmospheres worldwide [2] and aggregate to form larger assemblies. Dobbins concluded from TEM that flames and diesel engines generated nascent single nanoparticles (NPs) ($2 < d < 10\text{nm}$; $1.8 < C/H < 2.2$) that were precursors to carbonaceous fractal chain aggregates ($5 < C/H < 10$) and nanotubes [3], both with PAHs adsorbed thereon [4]. Lawther saw a relationship between air pollution and the incidence of bronchitis [5] and heart risks rise 38% for women who live within 49m of busy roads [6]. Nano-organic carbon (NOC) particles and hydrophobic soot NPs are emitted more from diesel- than gasoline-fuelled vehicles (i.e. the ratio of soot:NOC rises from 0.5 (gasoline engines) to 3.0 (diesel engines)). Here we describe the minimisation of carbonaceous UFP *and* CO_2 emission from generator and vehicle engines (using $\text{H}_2\text{-O}_2$ injectants and modified fuels (i.e. bio-esters in gasoline engines or water-in-biodiesel emulsions in diesel engines (see Figure 1))) and describe control of their primary particle size/fractality/PAH passenger load/hydrophobicity/toxicity/impact. Carbon is of the seven elements that have changed the world [7]; this work is focussed on making its nanoparticle impact (as we transition to a zero-carbon future) only positive.

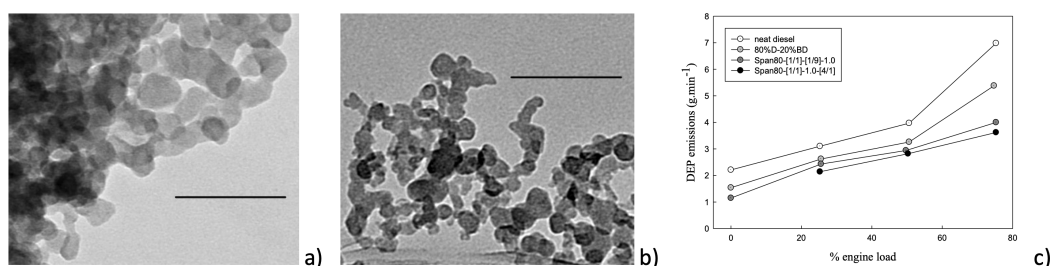


Fig.1 TEM micrographs of diesel emitted carbonaceous UFP particles with various tested fuels at 75% load: (a) diesel and (b) water-in-biodiesel emulsion (scale bars = 100nm). (c) Formation of DEPs is lower in Span 80 stabilised water-in-diesel/biodiesel emulsions at all loads.

References: [1] EU report on UFP emissions (2011); [2] D.Hasenfratz IEEE Internat.Conf.Pervasive Comput.Commun. (PERCOM) 69-77,(2014); [3] A.Evelyn Nano Letts 3,63-64,(2003); [4] R.A.Dobbins Aeros.Sci.Technol. 41,485-496,(2007); [5] P.J.Lawther Thorax 25,525-539,(1970); [6] Harvard Medical School; Jaime Hart; Daily Mail 14th Oct 2014 page 11; [7] J.Browne Seven elements that have changed the world. Weidenfeld and Nicolson (2013)