Novel Techniques for Characterization of Ultrafine Metal Aerosol Formation: Lessons from Diesel Combustion

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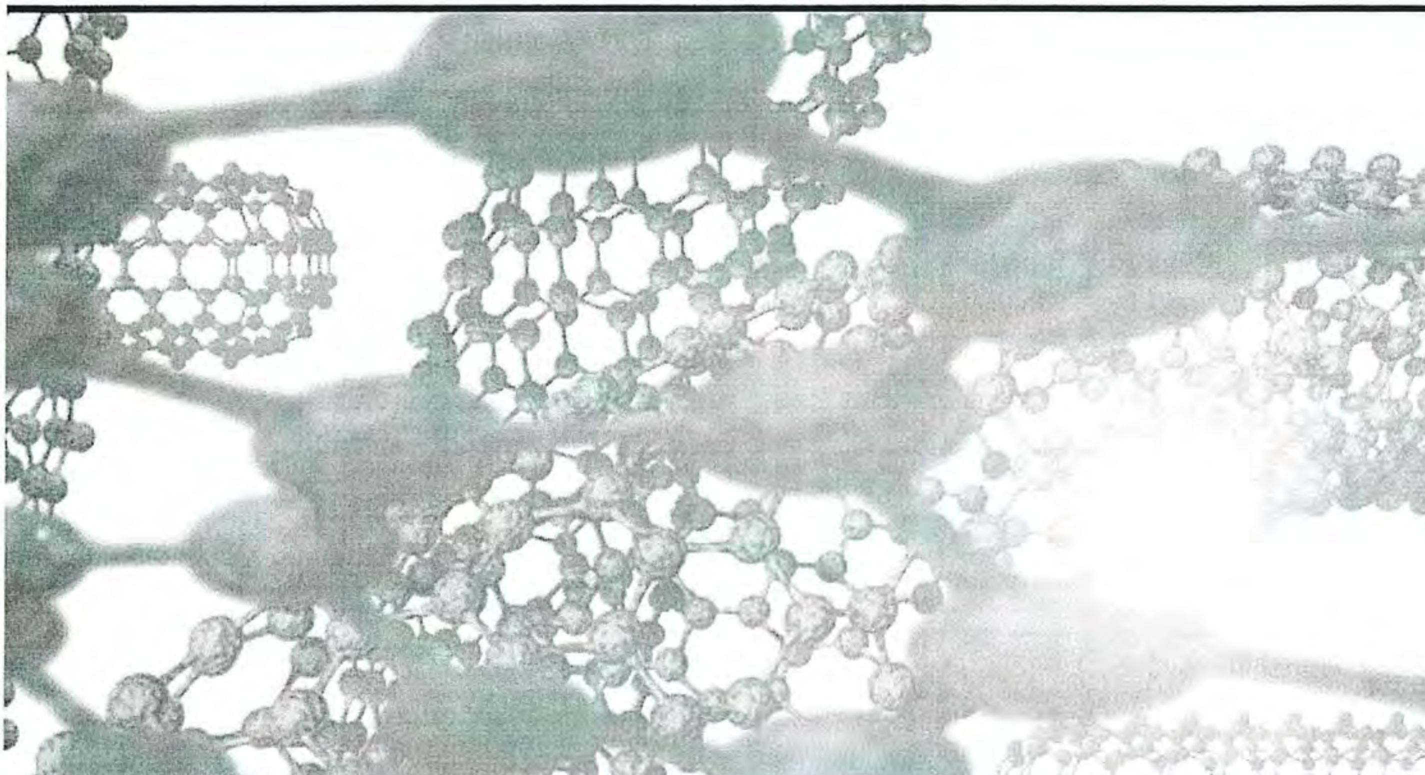
Many nanoparticles and nanomaterials involve carbon matrices in conjunction with metallic constituents. Insights into possible acute and chronic health effects from exposures to such nanomaterials may come from studies of diesel particulate matter (DPM). One theory holds that the potentially large number of ultrafine particles and their characteristic high lung-penetration efficiency may play a role in toxicity and that the presence of metals may be a contributor. This poster will discuss research approaches, insights, and findings to date from an investigation to characterize the metal content of diesel nanoparticles. NIOSH conducted this work in collaboration with the University of Minnesota. For the study, DPM was generated by a 1.5-liter diesel engine and ferrocene was added to the fuel in varying amounts to enhance the level of metal (in this case iron) in the system. The exhaust particles were analysed in real time using a recently developed single particle mass spectrometer (SPMS). In parallel, size selected samples were taken for subsequent analysis using transmission electron microscopy/energy dispersive x-ray spectroscopy (TEM/EDS). Results show that at a threshold Fe/C value of 0.013 (for this engine), self-nucleated metallic nanoparticles are formed and their number and size increase with level of doping. Iron-bearing particles that span a larger size range are also formed and it is observed that the metal to carbon ratios are greater for smaller particle sizes. Hydrogen to carbon ratios were measured and those ratios also increase for smaller sized particles. Agglomeration of metallic and carbon particles is observed in two distinct modes: attachment of iron primary particles (5-10 nm in diameter) to carbon agglomerates, and coagulation of iron agglomerates (20-200 nm in diameter) with carbon agglomerates. Results of this work imply that the generation of metallic nanoparticles could be fostered as new engine technologies reduce carbon levels in the engine, which could, in turn, potentially create a new health concern. The characterization approaches and insights from this work may guide the focus and design of studies to evaluate possible acute and chronic health risks of exposures to metal-containing nanomaterials.

Nanomaterials

a risk to health at work?



First International Symposium on Occupational Health Implications of Nanomaterials

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Report of Presentations at Plenary and Workshop Sessions and Summary of Conclusions

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