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Braking of automobiles: A potential source of nanoparticulate emissions

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Abstract

Considerable amounts of pollutants are generated by more than one billion registered vehicles worldwide. While the emissions related to exhaust gasses and tire wear were addressed extensively, the released brake wear debris and its impact were studied to a considerably lesser extent. Our previous work indicated that the released wear debris can have negative impact on environment. A characteristic automotive brake pad is a multicomponent composite typically formulated of more than 10 constituents. Manufacturers of brake pads worldwide use several thousand different raw materials, e.g. various metals and their compounds, carbon-based components and many others. This contribution addresses the character of wear debris released from a model friction material, used in a typical brake in Europe, USA and Asia. Brake samples were subjected to the standardized brake dynamometer test simulations and collected particles were further studied using a High Resolution Transmission Electron Microscopy with the EDX Microanalysis. Our experiments demonstrated that airborne wear particles with sizes between 10 nm and 20 µm can be released into the air. Phase analysis revealed numerous compounds which were not present in the original brake material. Nano-sized Cu, Fe, and Sn oxides and carbon particles were confirmed in the released coarse, fine and ultrafine wear debris fractions. Moreover, nano-sized wear particles were observed to be released after a contact with water from the non-airborne wear particles which settle on road surfaces. These findings proved contribution of braking of automobiles to nano-particulate air pollution which may potentially pose health risks in areas with heavy traffic.

Biography

Jana Kukutschova has completed his PhD and postdoctoral studies from Faculty of Metallurgy and Materials Engineering at VSB-Technical University of Ostrava, Czech Republic. She is the Head of Department of Bionanotechnology at Nanotechnology Center of VSB – Technical University of Ostrava. She has published more than 20 papers in reputed journals and is a member of American Nano Society, Society of Automotive Engineers and Czech Chemical Society.