Physical and chemical characterization of emissions from a EURO 7 brake dyno

Carsten Neukirchen, Mohammad Reza Saraji-Bozorgzad, Ajit Paul Mudan, Ralf Zimmermann, Thomas Adam

Institute of chemistry and environmental engineering, University of the Bundeswehr Munich, Werner-Heisenberg-Weg 39, Neubiberg, Germany
Carsten.Neukirchen@unibw.de

Automotive non-exhaust emissions, such as brake- and tyre wear are of rising interest, since they will be regulated for the first time with the EURO 7 regulation. While the majority of the particle mass of these abrasion derived particles is between 1 and 10 µm, a considerable percentage of the particle number is also generated in the nanoparticle range [1]. These particles can penetrate deep into the lungs, where they deposit in the alveoli and eventually reach the bloodstream via the blood-air barrier [2].

In this study the chemical and physical properties of brake wear particles emitted from a newly developed EURO 7 compliant brake dyno were characterized. Non asbestos organic brake pads (NAO), as well as so called low metallic brake pads (LM), were compared regarding emitted particle mass (PM), particle numbers (PN), as well as their size and morphology utilizing the WLTP bake cycle. Exemplary particle number concentrations of particles < 2.5 µm during a WLTP cycle are plotted in figure 1.

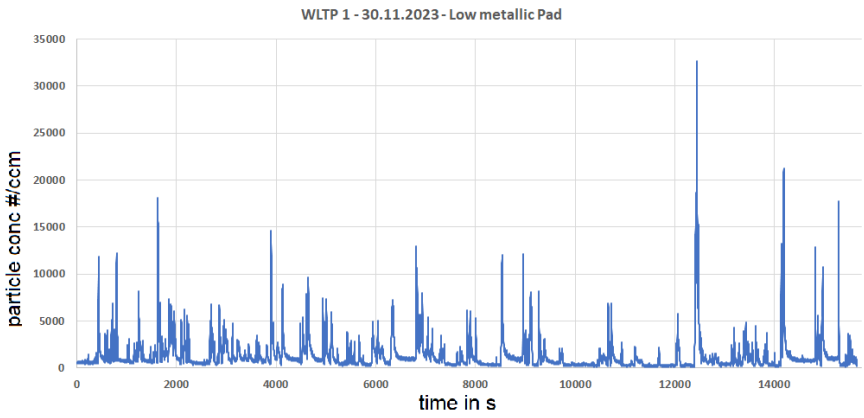

Figure 1: Particle number concentrations of Particle < 2.5 µm emitted by a LM brake pad during a WLTP cycle

Figure 2 depicts a typical SEM micrograph of brake nanoparticle, showing rough edges commonly found for abrasion derived particles. ICP-MS was used for bulk analysis of heavy metals, in combination with SEM-EDX for individual elemental particle spectra, to give a broader understanding of the highly metallic nature of brake wear derived particles.

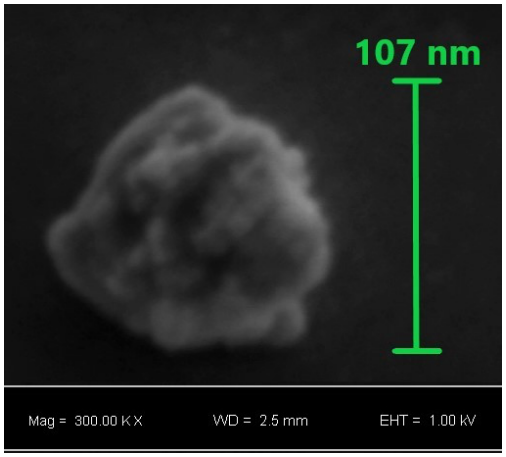

Figure 2: SEM micrograph of a brake wear particle emitted from a NAO brake pad

Furthermore, filters wear extracted and analysed for polycyclic aromatic hydrocarbons by GC-MS/MS to see if high local temperatures leads to generation of such carcinogenic substances at the brake interface due to thermal degradation of the polymer binding matrix of the brake pads.

[1] T. Grigoratos and G. Martini, Environmental Science and Pollution Research International, **2015** 22(4), 2491–2504.
[2] G. Bachler et al., *Particle and Fibre Toxicology*, **2015**, *12(1)*, 18.