P13: Characterization of tire wear particle emissions with Electron Microscopy

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Tires contribute to massive pollution through their abrasion. Affected are – among other things – soil, water, and air, which leads to health risks for the population. Characterizing tire particles related to abrasion is important to determine the origin of these particles.
For this reason, the FFG project “Green Tire” [1] was set up. It is concerned with tire abrasion, its recording, its characterization, and finally aiming for a reduction of emission particles.
These emissions should be collected under real driving conditions on the street and on a test bench. So far, first tire abrasion particles from the test bench could be analysed and characterized by Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). The chemical analysis has been carried out by means of Energy Dispersive X-ray Analysis (EDX) in SEM and TEM.
The holding device for collecting the particles on the test bench (left image) for SEM (center image) and TEM (right image) are shown in Fig. 1.

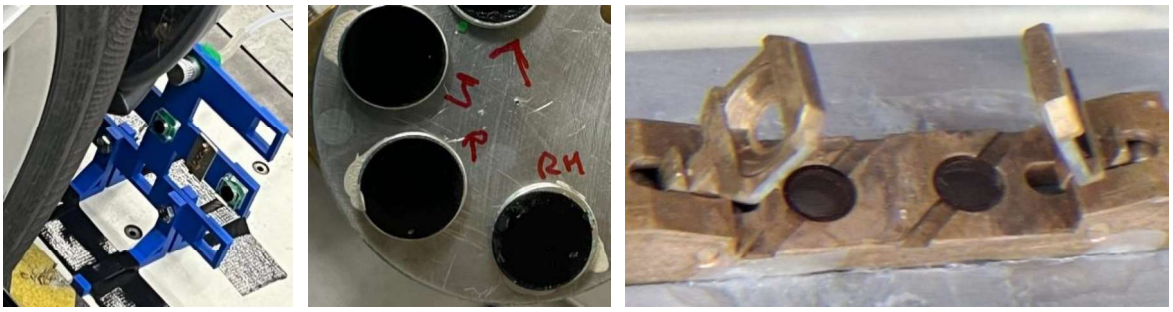

Fig 1: Collection of tire abrasion particles behind the rear tire in the lab on the test bench.

Larger particles of several µm size were investigated in SEM (Fig. 2 left), smaller particles of nm size in TEM (Fig. 2 right).

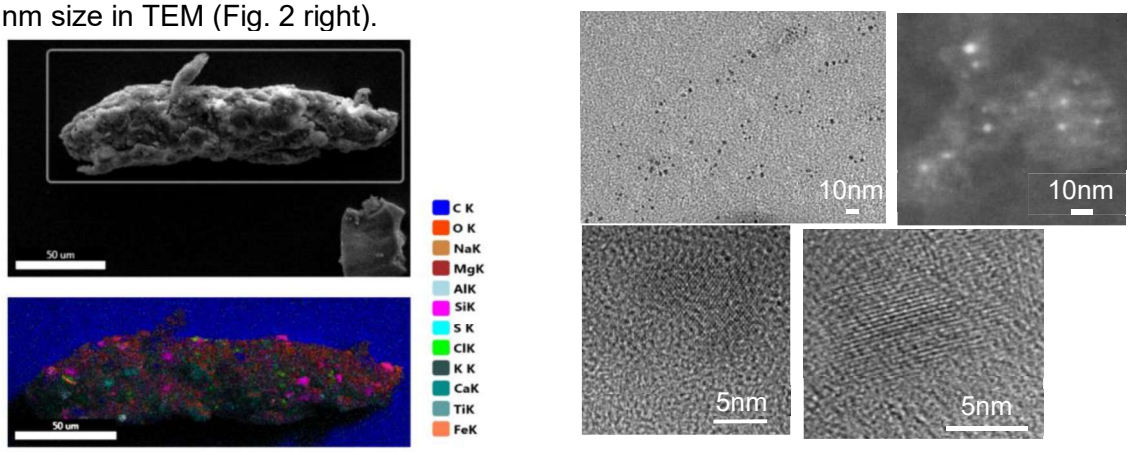

Fig. 2: SEM image and corresponding EDX map of a ~100µm large tire particle (left), and nanoparticles of <10nm diameter investigated in TEM (right) by HRTEM and STEM HAADF. All particles were placed on a Carbon support grid.

This research confirmed that the used setup was able to identify different sizes of particles, ranging from dimensions of several µm to nm range. Furthermore, tribological tests with the tire materials and simulations of different driving routines will help to develop a passenger car operating strategy for the reduction of tire particles.

[1] FFG Project “Green Tire”, https://projekte.ffg.at/projekt/5121078.