Morphology Controlled Reactivity of Carbonaceous Materials towards Oxidation

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Abstract

Recently, particulate matter from diesel engines has become an important topic in environmental, scientific, and political discussions. European legislation on particulate matter (PM) emissions has made significant advancement with the adoption of limit value standards up to and including Euro IV for heavy-duty (HD) engines. Efforts to reduce soot particulate from automotive engine exhaust have proceeded in two directions: optimisation of the combustion process to achieve a burnout of fuel to the highest possible extent and development of technologies for the treatment of soot particulate in the engine exhaust train.

This work is focussed on the so called "*after-treatment"* of soot, which is based on the installation of Pt-coated filter monoliths in the exhaust line that continuously regenerated by burning the soot deposited on the traps. Industrial Furnace soot (FW1), soot from a black smoking diesel engine (P1), Euro IV HD soot, spark-discharge soot (GFG) and hexabenzocoronene (HBC) are investigated with transmission electron microscopy and thermogravimetry. This study focuses on the reactivity towards oxidation of the Euro IV HD diesel engine soot. Results of this comparative study on microstructure and oxidative behaviour indicate a microstructure-controlled oxidative reactivity of the carbonaceous materials.

A Philips TEM/STEM CM 200 FEG transmission electron microscope equipped with a field-emitting gun is used to study the morphology and microstructure of the soot. The acceleration voltage was set to 200 kV. The investigations reveal the soot particle size distribution as well as the basic structural units (graphenes) of the soot particles (Fig. 1).

Thermogravimetric measurements were conducted using a Netzsch-STA 449 instrument with Al_2O_3 crucibles and product gas analysis using a Pfeiffer Omni Star MS. The samples were measured in 5% O_2 in N_2 which was maintained at a total flow rate of 100 ml/min. The TG/TPO analysis allows comparison of the combustion behaviour of the materials. There is a

focus on modelling the soot combustion with particular interest in microstructure-reactivity relations (Fig. 2).

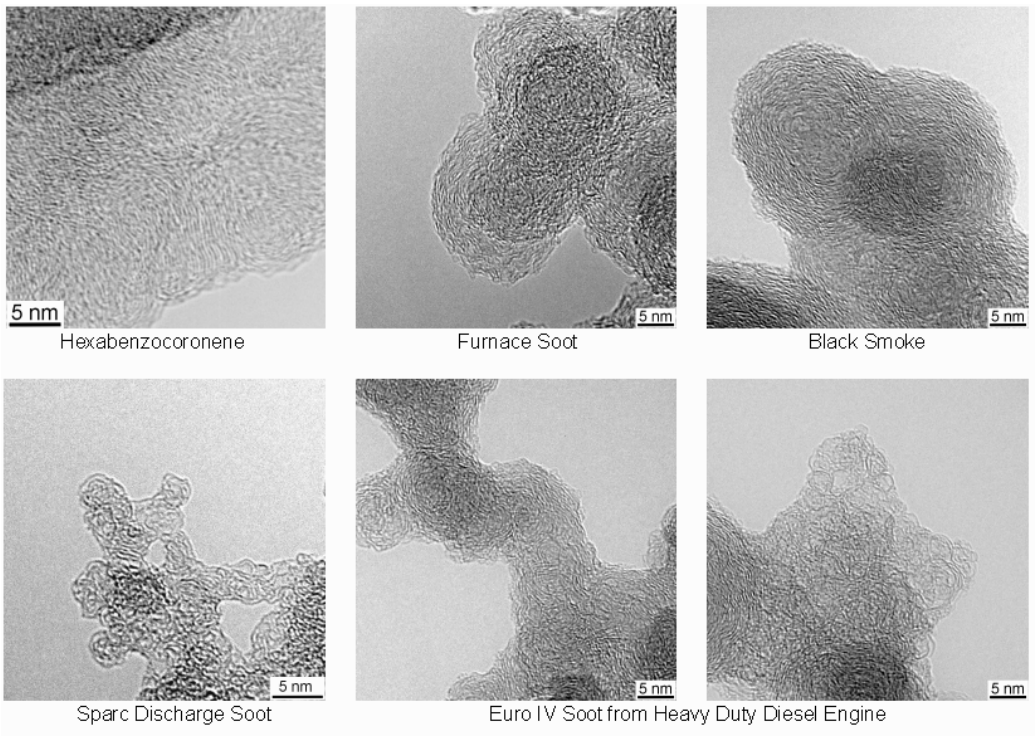

Fig. 1: HRTEM micrographs of carbonaceous materials

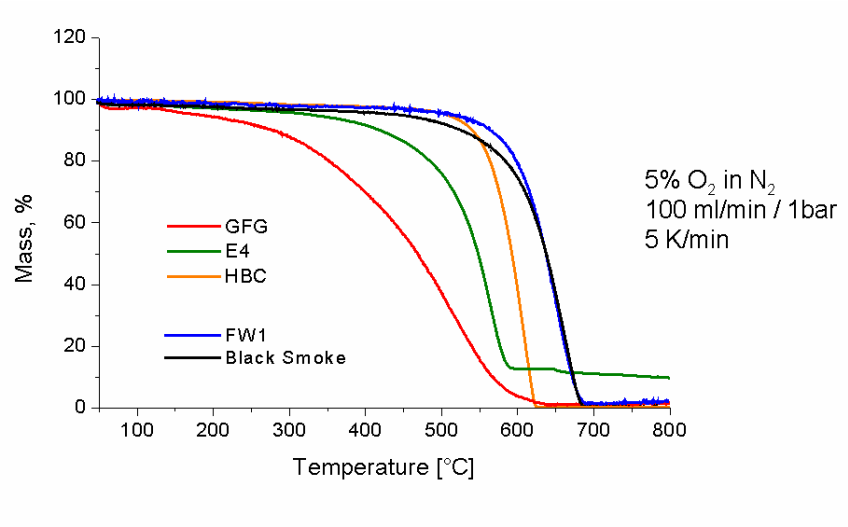

Fig. 2: TG/TPO measurements

Acknowledgement

This work is part of the Project: „PM-KAT: Katalytisches System zur filterlosen kontinuierlichen Rußpartikelverminderung für Fahrzeugdieselmotoren“ supported by the Bayerische Forschungsstiftung München, in cooperation with the MAN Group Nürnberg; Oberland-Mangold GmbH, Garmisch-Partenkirchen; Max Planck Institute for Polymer Research, Mainz; Institute of Hydrochemistry (TUM), München.