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Magnetic fraction of the particulate matter emitted from coal fired power plants

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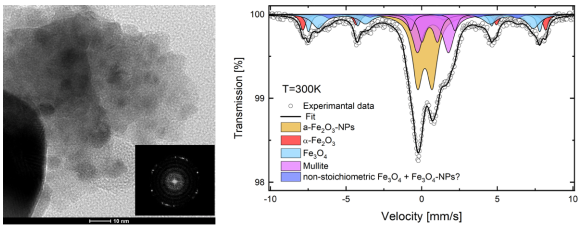

TEM image (left) and mossbauer spectra (right) corresponding to the sample from pulverized fuel boiler installation confirming a presence of iron oxides nanoparticles (Fe_2O_3) as well as iron enriched silicates.

Magnetic fraction of the atmospheric particulate matter is a problem of big concern because of important environmental and human health impact. Characterization of possible sources of emission of magnetic particles is important in interpretation of the composition of atmospheric aerosols and also in undertaking actions to reduce their concentration.

We analysed seven samples from three power plants fired with hard coal (two equipped with pulverized fuel boilers – PFB and one with fluidized bed boilers – FBB). Samples were collected from the material emitted to the atmosphere (after air pollution control installations). Samples were analyzed using ICP-ES/MS, XRD, SEM-EDS, TEM, Mössbauer spectroscopy, VSM and XAS as well as Pb and Fe isotopes analysis.

The content of Fe varies from 1.79 to 4.16wt%. The content of numerous trace elements is significantly higher than in the upper continental crust. Samples from PFB are enriched in Al, Fe, Ca, K, Na and S. Mullite and quartz dominate in all samples including separated magnetic fraction. Magnetite, hematite and a-Fe are predominant Fe containing phases. Sample from FBB contains also Ca sulphates and carbonate. Results of SEM-EDS analysis indicate significantly higher abundance of spherical particles in the material from PFB which can be related to the higher combustion temperatures. Samples from FBB contain more char particles. Fe rich particles exhibit complex internal structures. Fe is often present as minor component in aluminosilicate particles. According to TEM results Fe oxide phases are present often as fine particles (including nanoparticles 20-30 nm in size). Mössbauer spectroscopy reveals a presence of Fe_2O_3 and Fe_3O_4 (also in form of nanoparticles) in all samples (in remarkably different proportions depending on the boiler type), mullite in case of PFB and sulphates in case of FBB.

XAS spectra (Fe, Al, Mg) differ slightly in relation to the source (pulverized fuel boiler or fluidized bed boiler).

Comparison of $d^{56}Fe$ determined for four separated magnetic fraction and corresponding four bulk samples indicates higher values for magnetic fractions except the sample from fluidized bed boiler what also can be related to the difference in the combustion temperature.

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