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Characteristics of the nanoparticles in soot aggregates from Barcelona (Spain) during DAURE winter campaign: the closure of a complex state of mixture

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Nano-sized heavy metal compounds and mineral dust are frequently found as part of the structures in larger anthropogenic particles from urban environments (Adachi and Buseck, 2010). The study of these particles has received special attention in recent studies due to harmful toxicological and environmental effects. For instance, the heavy metal particles from combustion engine exhaust are associated to smaller sizes than the aggregate's monomer, falling within the range of maximum alveoli deposition able to entering into the blood circulation (Mayer et al., 2010). $PM_{2.5}$samples were collected for electron microscopy analyses during an atmospheric episode of thermal inversion in February 2009 in an urban background area within the city of Barcelona. This sampling was performed in the framework of a larger campaign DAURE (Determination of the sources of atmospheric Aerosols in Urban and Rural Environments in the western Mediterranean). The main goal of this part of the study was to quantify the characteristics of the nanoparticles hosted in the urban soot structures in the city during the winter DAURE campaign. Elemental composition and morphological parameters of several thousand particles were obtained by electron microscopy means.

Ultrafine silicates and metal particles were both abundant inside the soot structure of the urban samples, frequently coated by organic/inorganic layers. Silicates were found in nearly 50% of the soot particles. Nearly 65% of the Si-bearing particles were associated also to heavy metal compounds. In Barcelona, the presence of metal nanoparticles was quite variable from sample to sample, with percentages between 25% and 91%, associated to slightly smaller sizes to those of the monomers (Adachi and Buseck, 2010) and to higher concentrations during traffic peak hours. In average, the metal nanoparticles were present in 60$\pm$19% of the soot structures, a similar number to that found for the Mexico City study by Adachi and Buseck (2010). However, the composition and variety of these particles were far from similar in both studies. Fe, Cu and Pb were less abundant inside the soot nanostructures from Barcelona suggesting a link to different sources than those from Mexico City. Metal nanoparticles in soot were V, Cr, Ni, Ba, and Zn enriched. The abundance of these nanometals seems the closure of a complex coating structure comprised by mixtures of both nitrate and organic compounds (Coz et al., 2010).

References

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