Submicron particulate matter in urban atmosphere in Kraków (S Poland)

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High level of particulate matter (PM) in the atmosphere in Kraków is a problem of great concern. The significance of various emission sources of PM is a subject of debate but it is possible, based on single particle analysis, to prove that PM originates from residential heating, vehicular exhaust, industrial emission, and natural sources (e.g. soil erosion). Secondary aerosol particles (e.g. sulphates, secondary organic aerosol) are also abundant. High concentration of fine and ultrafine particles is typical. PM2.5 concentration is usually above 60% of PM10 but in winter seasons is above 70%.

Carbonaceous particles strongly dominate in PM1.0. Soot of various origin occurring as discrete particles (ca 50 nm in diameter) or clusters containing several particles is the most common in the studied material. Elongated often branched, chain-like particles or densely packed aggregates composed of numerous particle are present also. Spherical carbonaceous particles (up to 500 nm) or partly irregular particles represent probably secondary organic aerosols. Particles of this type are often seeded on soot particles.

Na, Na-K, Na-K-Ca, or Ca sulphates are present as irregular granular sulphate particles or polyhedral particles with rounded edges. KCl occurs as polyhedral, partly rounded particles. Sulphates and chlorides often develop on soot aggregates. Carbonates (usually Mg-Ca carbonates) were noted. Ca, Ca-K, Ca-Mg-K, Ca-Mg-K-Fe aluminosilicate particles occur as discrete grains or as aggregates often mixed with Na-K sulphate. Submicron quartz particles are scarce. Smooth spherical SiO_2 particles from 50 to 150 nm in size often form aggregates. Irregular Fe oxides are present usually in densely packed aggregates. TiO_2 particles (below 100 to 350 nm) form aggregates. Zn oxide occurs rarely. Al oxide spheres (100-300 nm) were noted sporadically. Sometimes particles are enriched in Cr, Ni or other metals.