Combined use of TEM/EDX, microRaman and AFM for characterizing single atmospheric particles

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Atmospheric aerosols are complex mixtures of particles suspended in the air with sizes ranging from a few nanometers to tens of micrometers Chemical characterization of individual particles is a challenging task. To comply with this objective, confocal Raman microspectrometry that combines the spatial resolution of optical microscopy and the molecular analysis capabilities of Raman scattering was used in order to acquire molecular information from individual micrometer-sized aerosol particles at ambient laboratory conditions [1]. By using multivariate curve resolution (MCR) technique [2] spectra of pure species and their corresponding spatial distribution within the micrometer scale were extracted simultaneously from the Raman images.

Detailed information on the size, morphology, chemical composition, and internal structure can be obtained by TEM/EDX. Modification of aerosol surface properties at different relative humidities (from 30% to 90%) can be investigated by atomic force microscopy (AFM) using an environmental cell [3]. Nanoscale imaging under controlled humidity conditions gives insights into aerosol activation processes (in-cloud processes) through successive humidities cycles.

Examples will be given from urban pollution events occurred in northern France. Our studies evidence local aerosols suffering ageing processes leading to the formation of new particles in different mixing states, e.g. internally-mixed vs externally mixed, from intrusion of long-range transported aerosols. Our observations serve as input geometry in algorithms for retrieving aerosol properties.

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