

Chemical imaging and micro-spectroscopic analysis of aerosol particles

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Aerosol particles range typically from a few nanometers to several micrometers in size and have significant impacts on climate, air quality, and health. These particles stem from a wide range of sources and are multicomponent and multiphase in nature. This physicochemical complexity makes it a challenge to assess the particles' roles in altering atmospheric processes. Scanning transmission X-ray microscopy with near-edge X-ray absorption fine-structure spectroscopy (STXM/NEXAFS) is uniquely suited to resolve particle morphology and composition on the nanoscale. STXM application within a multi-modal instrument approach is showcased to study atmospheric ice nucleation, which is a highly selective process, initiated by only a tiny fraction of the aerosol population. Chemical imaging of soil dust particles sheds light on the ice-nucleating agents on a single-particle level. This case study is followed by addressing future challenges in the field and required STXM capabilities. This includes the idea of "bringing the atmosphere into STXM", multimodal operation, AI/ML assisted analysis, and automated sample loading and analysis.

Significance

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Session Classification: Aerosol