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Direct sampling of sub-μm atmospheric particulate organic matter at sub-ng m^{-3} mass concentrations by proton-transfer-reaction mass spectrometry

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The chemical characterization of the organic fraction of atmospheric particulate matter is still a challenge. Herein we present the novel modular "Chemical Analysis of Aerosol Online" (CHARON) particle inlet coupled to a new-generation proton-transfer-reaction time-of-flight mass spectrometer (PTR-TOF 6000 X2, Ionicon Analytik, Austria). The PTR-TOF 6000 X2 detects organic analytes in real-time at sub-pptV levels by chemical ionization with hydronium reagent ions. The CHARON inlet consists of a gas-phase denuder for stripping off gas-phase analytes (efficiency > 99.999%), an aerodynamic lens for particle collimation, an inertial sampler for the particle-enriched flow and a thermodesorption unit for particle volatilization. With an enrichment factor of $\approx$ 30 for particle diameters (DP) between 120 nm and 1000 nm (lower enrichment for particles in the 60-to-120 nm diameter range), the CHARON PTR-TOF 6000 X2 system detects particulate organic matter online and in real-time down to 200 pg m^{-3}. Proton transfer from hydronium ions quantitatively ionizes almost the full range of organic analytes in the intermediate to low volatility range. The high mass resolution (R > 6000) and mass accuracy (< 5 ppm) of the Ionicon PTR-TOF 6000 X2 allows to assign elemental compositions to organic analyte ions over a large mass range. We will present a detailed characterization of the CHARON PTR-TOF 6000 X2 instrument and first results from ambient air measurements in Innsbruck (Austria).
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