2.038 Aerosol formation and aging under atmospheric conditions in China□application of a quasi-atmospheric aerosol evolution study (QUALITY) chamber.

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Abstract:

Secondary aerosol formation is the critical process for severe haze pollution in Beijing.

But the quantification of aerosol formation and aging from typical field measurements is affected by complex decoupling of the various processes. Here, a novel quasi-atmospheric aerosol evolution study (QUALITY) chamber is employed to mimic the aerosol formation and aging processes under ambient conditions. Several critical issues, i.e., aerosol nucleation, SOA formation from vehicles exhaust and aging of BC particles, are investigated by the corresponding well-designed QUALITY chamber experiments.

(1) Consistent aerosol nucleation and growth were revealed in the ambient atmosphere in Beijing. Organic species is dominantly responsible for both the nucleation process and the growth of the fresh nucleated particles. The photochemical oxidation of vehicular exhaust consisting of mainly organics play the key role in new particle formation under polluted ambient conditions.

(2) The impacts of gasoline vehicle type and fuel content on SOA production were investigated. A significant amplification factor of 3–6 for SOA productions from gasoline exhausts was observed as gasoline aromatic content rose from 29 to 37%. Much higher SOA production was found from the exhaust of the gasoline direct injection (GDI) vehicle than that from the port fuel injection (PFI) vehicle under high NOx condition. Single-ring aromatic VOCs could explain only 25-53% of the measured SOA formation. More IVOCs and SVOCs were inferred as being emitted by the GDI vehicle.

(3) Aging and variation in the particle properties of BC particles were evaluated under atmospheric conditions. BC aging exhibits two distinct stages, i.e., initial transformation from a fractal to spherical morphology with little absorption variation and subsequent growth of fully compact particles with a large absorption enhancement. The timescales to achieve an absorption amplification factor of 2.4 for BC particles are estimated to be 2.3 h in Beijing.