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# The roles of organics in New particle formation in the Megacity of Beijing, China

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The new particle formation (NPF) has been investigated in the high aerosol loading environment of Beijing since March 2004. The occurrence frequency is comparable with less aerosol loading environment, whereas the monthly or seasonal variations indicate location dependency. Simultaneously measurements of gaseous precursors of $H_2SO_4$ vapor and ammonia proved that the $H_2SO_4$-$NH_3$-$H_2O$ ternary nucleation is an important mechanism for Beijing NPF, which is mainly constrained by the concentrations of the gaseous sulfuric acid and total particle surface area. The higher particle formation rates were observed on high aerosol loading days, followed up NPF, then high organic matter observed by AMS, which indicated the organic vapors should be involved in the new particle formation process.

The roles of organics in the formation and growth of the NPF were focused on in the case of summer 2008, Olympic Games period, the particle formation rates show good correlations with sulfuric acid and organic vapors implying that both play an important role in the atmospheric new particle formation. The best fit between observed and modelled particle formation rates is achieved with the homogenous nucleation theory of sulfuric acid (both homomolecularly and hetermolecularly) with separate coefficients in $J = K_{SA1}[\mathrm{H_2SO_4}]^2 + K_{SA2}[\mathrm{H_2SO_4}][\mathrm{Org}]$, in which the contributions of the sulfuric acid and the organics involving terms have been estimated as 43% and 57%, respectively. The growth of new particles contributed by condensation and neutralization of sulfuric acid, coagulation as well as organic compounds involved growth are discussed. The apparent growth rates vary from 3 to 11 nm $h^{-1}$. Condensation of sulfuric acid and its subsequent neutralization by ammonia and coagulation contribute to the apparent particle growth on average 45$\pm$18% and 34$\pm$17%, respectively. The 30% higher concentration of sulfate than organic compounds in particles during the sulfur-rich NPF events but 20% lower concentration of sulfate during the sulfur-poor type suggest that organic compounds are an important contributor to the growth of the freshly nucleated particles, especially during the sulfur-poor cases.