New particle formation and growth in the urban atmospheric environment

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The transformation from low-volatility vapors to new particles (new particle formation, NPF) is a frequent phenomenon in various atmospheric environments and it impacts aerosol number concentration, cloud formation, and hence climate. In comparison to numerous NPF studies in clean atmospheric environments, however, NPF mechanism in polluted atmospheric environments remains elusive. For instance, the new particle formation rate of 1.5 nm particles in urban Beijing was found to be magnitudes higher than those reported in relatively clean atmospheric environments. Polluted environments often have high concentrations of precursors and high aerosol loadings. Therefore, the scavenging of newly formed particles due to coagulation contribute significantly to the formation and the growth of new particles. The clustering of H_2SO_4 and amines is a possible mechanism driving the fast nucleation and initial growth of new particles against the scavenging by the high aerosol concentration in the polluted urban environment. However, the molecular-level mechanism and governing factors for H_2SO_4-amine nucleation have not been quantitatively investigated in the real atmosphere. Based on long-term atmospheric measurements in urban Beijing, the critical step of acid-base nucleation in the urban atmosphere will be discussed. The influences of precursor concentrations, aerosol loading, and temperature on particle formation rate are quantitatively addressed. Atmospheric species contributing to particle growth are revealed.

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