

项目批准号：91644103

项目名称：二次有机气溶胶液相生成机制和化学过程的碳氮稳定同位素研究

资助类别：重大研究计划

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项目摘要：

二次有机气溶胶(SOA)的形成机制和化学过程研究是大气化学领域的研究热点，而液相化学过程已被揭示为SOA形成和老化的重要途径之一。但现有的实验模拟结果主要是基于某类化合物(如短链羰基化合物)的研究，未完全考虑大气颗粒物或云滴复杂基质对液相化学过程的影响。本项目拟以大气固定源和环境颗粒物样品为研究对象，研究其在液相体系下不同条件下的反应动力学、机制以及碳氮稳定同位素比值的变化特征及其关键影响因子。同时，利用污染物在线和离线分析手段，揭示典型城市(天津和南京为例)大气细颗粒物的SOA分子标志物、水溶性有机碳氮以及碳氮稳定同位素比值的演变特征，重点评估稳定同位素组成特征与气象要素、颗粒物化学组成、气溶胶液态水含量和酸度等影响因素的相互关系。本项目旨在揭示大气复合污染下SOA液相化学过程、演变特征及其对细颗粒物形成的影响和作用机制，为大气复合和灰霾污染下细颗粒物的化学过程研究提供基础科学依据。

关键词：二次有机气溶胶；液相化学过程；稳定同位素比值；有机碳；有机氮

Abstract(limited to 4000 words): In recent years, studies that focus on formation and process of secondary organic aerosols (SOA) have been becoming a research hotspot in atmospheric chemistry. Aqueous formation and process are considered as one of major formation and/or aging pathways of SOA. However, most of the laboratory studies conducted so far have been based on specific compound or class compounds (i. e., small chain carbonyl compounds) in idealized systems, that is, the aqueous solutions do not reflect the complex mixture of organic and inorganic aerosol constituents as in atmospheric aerosols and cloud droplets. In this project, we will conduct batch aqueous-phase experiments under different conditions on aerosol samples from point sources and typical ambient samples collected in urban areas. In proposed aqueous-phase laboratory experiments, kinetics, formation/aging mechanism, characterization of variation of isotope compositions as well as their controlling factors will be extensively assessed under different experimental conditions. The tracer compounds of SOA, mass concentrations of water soluble organic carbon and organic nitrogen and stable carbon and nitrogen isotope ratios in fine aerosol samples will be characterized at a comprehensive way in two typical cities such as Tianjin and Nanjing, together with online and offline measurement methods. The correlations among stable carbon and nitrogen isotope ratios, chemical compositions and meteorological factors as well as aerosol water content and acidity will be also disclosed. In general, the objective of this project is to broaden our knowledge of formation and chemical process of aqueous-phase SOA and its roles and

mechanism in the formation of air pollution complexes and gray haze. In general, our study will provide fundamental information for researches on the chemical process of atmospheric fine aerosols in an air pollution complex and haze episode.

Keywords: Secondary organic aerosols; aqueous process; stable isotope ratios; organic carbon; organic nitrogen