International Scientific Journal
Journal of Environmental Science
http://environment.scientific-journal.com/

# Key Factor Identification for PM2.5 Formation in China: The Role of $NH_3$ in Atmospheric New Particle Formation

Dehong Xia[1,2 *], Xin Liu[3], Binfan Jiang[1,]

[1]School of Energy and Environmental Engineering, University of Science and Technology Beijing, Beijing 100083, China
[2] Beijing Key Laboratory of Energy Saving and Emission Reduction for Metallurgical Industry, University of Science and Technology Beijing, Beijing 100083, China
[3] Beijing Society of Thermophysics and Energy Engineering, Beijing, China

*Presenting author: Professor Dehong Xia
School of Energy and Environmental Engineering,
University of Science and Technology Beijing,
Beijing 100083, China

Tel: +86 10 62334723
Fax: +86 10 62329145
E-mail: xia@me.ustb.edu.cn

Abstract
PM2.5 (particulate matters with aerodynamic diameter smaller than 2.5 μm) pollutions with adverse effect on human health and global climate has occurred frequently and caused widely concern in China. The main chemical compositions in PM2.5, *i.e.,* $SO_4^{2-}$, $NO_3^-$, $NH_4^+$ and organic compounds, are converted from $SO_2$, $NO_x$, $NH_3$ and volatile organic compounds (VOCs), respectively. In order to find out the key factor for PM2.5 generations to help to relieve the air pollution, formation characteristics of PM2.5 is investigated. A property of electric neutrality of PM2.5 is proposed according to the least-energy principle and verified through electricity-charge calculation in this paper. As the only cation in the main chemical compositions of PM2.5, $NH_4^+$ is vital for anions (such as $SO_4^{2-}$ and $NO_3^-$ ) to aggregate together and is a key factor for PM2.5 formations. The major source of PM2.5 is secondary new particulate formations (NPF) in atmosphere. Herein, to identify the role of $NH_3$ in atmospheric NPF, a new kinetic model, combining the oxidation of $SO_2$/$NO_2$ in $SO_2$/$NO_2$/$NH_3$/$H_2O$/air system and the aggregation of clusters in $H_2SO_4$/$HNO_3$/$NH_3$/VOC system, is established based on gas-kinetic theory. From the modeling analysis, it is found that $NH_3$ can enhance PM2.5 formations not only by facilitating conversions of $SO_2$ and $NO_2$ indirectly, but also by promoting aggregations of $H_2SO_4$, $HNO_3$, $NH_3$ and VOCs directly. And the enhancement of conversion fractions for $SO_2$ and $NO_2$ during oxidation processes is the major effect of $NH_3$ on PM2.5 formations. In addition, the presence of $NH_3$ can particularly promote the contribution of $HNO_3$ in NPF process. Therefore, in order to relieve PM2.5 pollutions in China, the control strategies for $NH_3$ as current restrictions on $SO_2$ and $NO_x$ are suggested to be enhanced by government, such as decreasing the amount of nitrogenous fertilizer utilization, or changing the fertilizing environment from dry condition to wet condition.

**Keywords**: PM2.5, $NH_3$, new particle formation, modeling studies, haze mitigation