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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of NO_2 and C_3H_6 on the heterogeneous oxidation of SO_2 on TiO_2 in the presence or absence of UV irradiation" *by* Biwu Chu et al.

Anonymous Referee #3

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This manuscript presents an experimental study on the influence of NO2 and a specific VOC (propene) on the heterogeneous production of sulfate on TiO2 particles. The study argues for the complexity in the situation of multiple precursors. The topic fits well in the journal. However, there are significant issues within the manuscript. Below are the major, minor and technical comments. They should be satisfactorily addressed before consideration for publication in the final ACP. Major: A major question that I have is on the set up of the experiments in which many details are missing in the current manuscript. Specifically, (1) is relative humidity controlled? A lot of previous studies show the importance of RH in heterogeneous reactions. RH (or the abundance of water vapor) also impacts gas phase reactions through HOx cycle. (2) about UV light

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Discussion paper

illumination. What is the amplitude and the range of wavelength? Is it represent of the real atmosphere? (3) the detection of ion chromatography. Is it interfered by HMS hydroxymethanesulfonate? (4) Rational of the choice of materials: TiO2 and propene. How well do they represent the aerosol particles and VOCs? These above questions should be clearly answered in the manuscript. The second one is on the structure of the manuscript. Currently, a big chunk of the method description resides in the results and discussion. I suggest that the authors should re-organize the structure and separate method, results, and discussion (three sections). The experiments conducted in this study should be summarized at first in the method section. In the discussion section, a more thorough and clear discussion on the influencing factors of SO2 oxidation should be provided. The third one is on the proposed mechanisms which in my opinion are not well justified. The study intends to explore the underlying mechanisms through different combinations of chemical precursors. The proposed mechanisms are specifically related to the production and/or competition for ROS and surface reactive sites. But the study does not provide a good way in the experiments to argue for the importance of ROS and reactive sites. What are differences in terms of production and fate of ROS under dark and illumination conditions? Is there a way to detecting the saturation of surface reactive sites? Minor: Page 5, Line 9-10: Elaborate on the processes leading to surface water formation. Page 9, Paragraph 2: Elaborate on the different effects of different VOCs from previous studies. The authors may consider move Figure 2 to the supplemental. Technical: Page 1, Line 17: full expression for “DRIFTS” Page 2, Line 5: “the mechanisms of heterogeneous reaction processes as well as their”

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