

Response to Dr. Chen (Referee)

Thank you very much for your time and constructive comments. Here are our responses to your comments.

This work reported the heterogeneous reaction of peroxyacetic acid (PAA) and hydrogen peroxide (H_2O_2) on ambient fine particles at different relative humidities and found that this heterogeneous reaction could be an important but yet unconsidered loss pathway of gaseous PAA. The work is of interest to atmospheric chemistry community and the results can help to better understand the atmospheric budget of peroxides and their impacts on atmospheric chemistry. In this regard, I would recommend publication of this paper in ACP after the authors fully address the points as follows.

Major revisions:

1. Page 5718 line 25-26: Give a more detailed description of the uptake experiments, e.g., the reaction time for each RH, any treatment of the samples before moving to next RH.

A: The uptake experiment at a certain RH took 2 h for PAA and 1 h for H_2O_2 ; including the time for the balance of peroxide on blank filter and particles-loaded filter. The balance concentrations of PAA/ H_2O_2 have been detected at least for three times. The RH was then changed to a different value with no any treatment for the filter samples. The resolution of PAA and H_2O_2 concentration measurements corresponds to the HPLC retention time of PAA and H_2O_2 , which is 8.9 min and 4.0 min, respectively. There is no any treatment before moving to the next RH. We have added a detailed description into the revised manuscript.

2. Page 5724 line 4-6: How did the authors conclude that “the larger value of H_2O_2 than that of PAA in low humidity indicated a physical process is important for the uptake of H_2O_2 onto $\text{PM}_{2.5}$ when humidity is low”?

A: Thank you for pointing out this. In this study, we suggest that chemical process dominate the uptake of peroxide rather than physical process and $R_{y,\text{PAA}}$ is larger than $R_{y,\text{H}_2\text{O}_2}$. However, $\gamma_{\text{H}_2\text{O}_2}$ at low RH is larger than γ_{PAA} , we once considered this might suggest the importance of physical process in low humidity. Now, we find this statement is not appropriate and we have deleted it in the revised manuscript.

3. Page 5724 line 9-10: It cannot be seen from Figures 3 and 5 that the measurements

of PAA and H₂O₂ are performed with both increasing and decreasing RH.

A: In the revised manuscript, we have used different symbols for γ values obtained with ascending and descending RHs (see Fig. 3 and Fig. 5).

4. Page 5728 line 24-26: Give the data to support that ADS particles are coated with salts but ATD not.

A: We used ultrasonic method to extract the sulfate ion of ADS and ATD particles. The concentration of SO₄²⁻ in ADS and ATD particles was 20.3 $\mu\text{g mg}^{-1}$ and 0.2 $\mu\text{g mg}^{-1}$, respectively. The concentration of NO₃⁻ in ADS and ATD particles was 0.97 $\mu\text{g mg}^{-1}$ and 0.21 $\mu\text{g mg}^{-1}$, respectively. The concentration of NH₄⁺ in ADS and ATD particles was 0.98 $\mu\text{g mg}^{-1}$ and 0.52 $\mu\text{g mg}^{-1}$, respectively. The concentration of Na⁺ in ADS and ATD particles was 5.13 $\mu\text{g mg}^{-1}$ and 0.52 $\mu\text{g mg}^{-1}$, respectively. We have added these data into the revised manuscript.

5. Page 5729 line 5-7: The conclusion “chemical processes rather than physical processes dominate the heterogeneous reaction of peroxide compounds on PM_{2.5} and aged mineral dust particles” is contrary to that “physical process is important for the uptake of H₂O₂ onto PM_{2.5} when humidity is low” (Page 5724 line 4-6).

A: Thank you for pointing out this. This is the same with Question 2. Due to the previous statement is not so appropriate, we have deleted the latter one.

Minor revisions:

1. Page 5723 line 3 and 8, and Page 5725 line 14: The definition of H₂O is already given on page 5722 line 22.

A: We have deleted the extra definitions.

2. Page 5727 line 17-19: The literature result is not helpful to explain the positive RH dependence of the uptake coefficient of H₂O₂ on PM_{2.5}.

A: We have deleted the discussion based on this literature result.

3. English usage needs to be significantly improved (here are just some examples)
Page 5715 line 18: delete “on” Page 5716 line 3: “undertook” should be “undertake”
Page 5720, line 21: “dispersive” should be “dispersed” Page 5727, line 25: delete “consider”.

A: We have corrected the errors in English usage the reviewer pointed out and we found and believe that the English is significantly improved in the revised manuscript.