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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Uptake of HO_2 radicals onto Arizona Test Dust aerosols" *by* P. S. J. Matthews et al.

Anonymous Referee #2

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General comments:

The authors describe laboratory experiments to determine uptake coefficient of HO2 onto Arizona Test Dust particles using an aerosol flow tube coupled to an instrument based on laser-induced fluorescence (LIF). Although generation of the particles was unstable, the uptake coefficient was determined successfully as functions of initial HO2 concentrations, relative humidity, and exposure time. The determined uptake coefficient (0.031) was used to assess the impact of the heterogeneous process on the ambient HO2 concentration levels at Cape Verde when dust was present at high concentrations. Many of recent observational studies on the atmospheric HOx radicals reported lower-than-expected HO2 (or HO2*) concentrations and thus any possible heterogeneous loss of HO2 onto various types of particles must be studied. The result

here is valuable, because the heterogeneous loss experiment on dust particles was made for the first time with an aerosol flow tube coupled to a sensitive LIF instrument, realizing loss measurements of HO2 at realistic ambient concentration levels. However, there are several points need to be clarified. One is on the mechanism. The authors should explain if 1st order loss (implicitly assumed in equation (3) for the determination of uptake coefficient) is still effective with the proposed mechanism (R3-R7) involving recombination of HO2, and if the observed lower uptake coefficient with higher HO2 initial concentration is in line with the proposed mechanism. Another is on the box model assessment of the impact. The assumption that the gas diffusion limitation is avoided (equation (9)) should be justified, even if the dust particles present in the atmosphere were coarse. The paper is publishable after the authors successfully address to the issues raised above and the following specific points.

Specific comments:

1. Page 4229, Title. The paper title is very similar to that of Bedjanian et al. 2013. I may add "measured with an aerosol flow tube method" at the end of the title. Maybe "Arizona Test Dust particles" is better.

2. Page 4231, lines 23-26. It seems from the sentences that Bedjanian et al. (2013) used an aerosol flow tube, which is not the case.

3. Page 4232, line 17. How do the authors define the length? From the point where mixing of HO2 with particles takes place to the aperture of the HO2 detection cell?

4. Page 4234, lines 9-14, Figure 1. Did the FAGE instrument sample almost all the gas flowed into the flow tube? Or additional overflow line is present?

5. Page 4234, line 15. Were the dust particles sieved before put into the disperser, to obtain relatively narrow size distribution shown in Figure 2?

6. Page 4235, lines 5-12. Did the raw SMPS measurement provide Stoke's diameter?
7. Page 4236, line 20. Define r_s.

8. Page 4236, line 21, Page 4242, lines 8-14. Clearly mention that the uptake coefficient is determined assuming spherical particle shape in this study.

9. Page 4237, line 9, equation (7). 0.283

10. Page 4237, line 15. The title of the subsection can be simply "Time dependence of the uptake coefficient"

11. Page 4239, equations (R3)-(R7). The authors should explain if 1st order loss (implicitly assumed in equation (3) for the determination of uptake coefficient) is still effective with the proposed mechanism (R3-R7) involving recombination of HO2.

12. Page 4239 line 13. How fast can the surface be saturated? Rough estimation is possible.

13. Page 4239. Can the saturation be delayed if using larger amount of particles, while fixing HO2 concentrations?

14. Page 4240, line 25. Aerosol particle surfaces used in this study can also be regarded as solid surface. Use "coated surface."

15. Page 4241, lines 11-13. I did not understand why high humidity resulted in lower HO2 concentrations. Did the author mean partition into HO2-H2O?

16. Page 4244, line 2. Mention that the gamma value used here is in the higher side of the observed range.

17. Page 4244, lines 3-7. What is the size distribution of the ambient dust particles? Can they be represented by 1 um? The assumption that gas-phase diffusion does not limit the loss process is made with equation (9). Is it still valid?

18. Page 4245, lines 23-24. The discussion on the rate determining step should have appeared earlier.

19. Page 4246, line 16. Kumar et al. (2014) did not appear in the reference list. Also

include references Dentener et al., 1996; Seinfeld et al., 2004; Tang et al. 2014; Read et al. 2008; and Whalley et al. 2008, found in text.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 4229, 2014.