Atmospheric Chemistry and Physics Discussions

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Comment on acp-2022-328

Anonymous Referee #1

Referee comment on "A comprehensive study on hygroscopic behaviour and nitrate depletion of $NaNO_3$ and dicarboxylic acid mixtures: implications for nitrate depletion in tropospheric aerosols" by Shuaishuai Ma et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-328-RC1, 2022

This work performs a comprehensive study on the hygroscopic growth and chemical composition evolution of mixtures of $NaNO_3$ and DCAs with two FTIR techniques. The phase transition and nitrate depletion for the mixed particles are monitored in real time by IR spectra and described in detail. The results indicate that chemical component, phase state, and water activity of mixed particles, as well as HNO_3 gas phase diffusion may play important roles on HNO_3 release from nitrate and DCAs mixtures. In view of that this work provides a comprehensive and significant research on the phase transition behaviors of nitrate/DCAs mixtures and the influence factors for nitrate depletion, I support the publication of this paper in ACP after addressing the following comments.

Comments:

- In the abstract, the authors suggested that "The HNO_3 release from $NaNO_3$/OA mixtures was observed in both the measurements, owing to the relatively high acidity of OA". What does "the relatively high acidity of OA" mean? Compared with MA and GA, or HNO_3? This should be revised to avoid misunderstanding.
- Line 37: Is there considerable amounts of nitrates present in sea salt aerosols? Or did the nitrate depletion frequently occur in sea salt aerosols?
- The authors observed the $NaHC_2O_4$ formation in $NaNO_3$/OA mixed system, and then $NaHC_2O_4$ was transformed into $Na_2C_2O_4$ with further nitrate depletion. Whereas, MA was found to produce monosodium malonate as it reacted with nitrate. Why? Please clarify it in the text.
- Line 132: "Likewise, Wang et al. (2017) observed the formation of $NH_4HC_2O_4$ in mixed $(NH_4)_2SO_4$/OA droplets upon drying." So what's the similarity of Wang's study and this work? Did they propose the similar driving force for $HC_2O_4^-$ ions formation?
- Line 143: As indicated in this work, $NaNO_3$ deliquescence proceeds at 46.9%-61.9% RH for $NaNO_3$/OA mixtures and ~65%-77% RH for pure $NaNO_3$ This implied that $NaNO_3$

solids began to deliquesce at RH significantly lower than its DRH. So is the deliquescence process a thermodynamic process or a kinetic process?

- Line 168: The authors observed phase transition and nitrate depletion of 1:1 $NaNO_3$/OA mixtures in Sec. 3.1, but why did they choose 3:1 mixtures to further investigate the phase state effect?
- Line 231: The 15% RH was only a preset RH value with stepwise increasing RH, so it should be revised to "As RH increases to around 15% (or even lower)".
- Line 287: The authors also observed the chlorine depletion in 1:1 mixed NaCl/MA particles with two different RH changing rates, but a brief discussion about the experimental results should be presented in the text.
- Line 413-424: I suggest that this paragraph should be rewrote to better illustrate the atmospheric implications of the experimental observations in view of the presence of mineral dust inclusions and so on in atmospheric aerosols, which constantly induce the heterogeneous nucleation of aerosols at relatively high RH.