

General comments:

This paper reports measurements of aerosol particles in the Arctic using different microscopic techniques. These measurements are very important and provide some interesting results. However, I found that the data interpretation and discussion are somehow weak, and many conclusions are too strong but very speculative. I would suggest that more concrete and convincing discussions should be given to the measurement itself), instead of speculating its atmospheric implications. Overall, this manuscript requires major revision before I can recommend it for final publication.

Major comments:

1. I fully agree with the comments made by ref. 1. Especially, nitrate has not been detected but inferred. Authors should provide a convincing explanation why nitrate has not been detected by any of these techniques they used, and justify how nitrate was inferred from their measurement.

2. Page 16724, line 10-12: it is claimed that because aged SSA particles are more spherical compared to fresh ones, aged SSA particles tend to be droplets. I disagree with it. Although the conclusion can be true, the observation that aged particles are more spherical is only related to crystallization processes during dehumidification, and is not necessarily related to these phases at high RH.

3. Page 16727, line 1-3: I am not convinced that NaNO_3 coating totally determines the hygroscopicity and optical properties of aged SSA particles. At most the measurements may suggest that aged SSA particles are more likely to be droplets in the ambient air, compared to fresh SSA particles. To make such a strong claim, the authors are required to present data of hygroscopicity and optical properties for both fresh and aged SSA particles.

In addition, I think even fresh SSA particles are likely to be droplets for ambient RH of 56-94%. Though pure NaCl has a DRH of 0.77%, its ERH is much lower. By the way, even fresh SSA particles should not be pure NaCl, but containing other salts which are contained in sea water.

5. Page 16727, line 19-24: if surface reactions produce Cl_2 , the photolysis of Cl_2 will produce Cl atoms, further enhancing the photochemical reactivity. I am not sure why it will reduce the overall photochemical reactivity. More explanations should be provided.

6. Page 16727, line 17-19: one of the four reactions will produce ClNO_2 ; instead, it is formed in the reaction of N_2O_5 with Cl^- .

6. Page 16729, line 2-3: what the author found is that organic compounds are coated on aged SSA particles, and I am not sure that it is equal to phase separation used in atmospheric chemistry community. Since the editor is an expert in this field, I will leave the decision to the editor.

Minor comments:

Figure 6: I feel “volume equivalent diameter” is more proper than “equivalent spherical diameter”.

Page 16722, line 18: “don’t experience” should be “have not experienced”. Although the paper is not difficult to follow, it will benefit a lot if it can be revised and edited by a native speaker.