Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2021-1065-RC2, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on acp-2021-1065

Anonymous Referee #2

Referee comment on "Different effects of anthropogenic emissions and aging processes on the mixing state of soot particles in the nucleation and accumulation modes" by Yuying Wang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-1065-RC2, 2022

The authors present a five-month aerosol volatility measurement at a suburban site in North China Plain, focusing on analysis and interpretation of data from a volatility tandem differential mobility analyzer (VTDMA). The manuscript is like a measurement report. Throughout the manuscript, the authors tried to explain their measurements by some reasons that they could not demonstrate, using the sentences "likely caused by…"ï¼□"likely due to…"ï¼□"likely because of…." to interpret their results. Some discussions and conclusions are not reasonable and even wrong. For example, the authors conclude that anthropogenic emissions could weaken the volatility of soot particles and enhanced their degree of external mixing, which can not be supported by the measurement results that show increased fractions of non-volatile mode soot (i.e., externally mixed BC) and decreased coating depth with size increase. These measurement results follow the diffusion growth theory, namely condensation process of secondary aerosol components (i.e., coating materials) on soot surface is more sensitive to smaller size particles, in other word, the coating growth is effective for smaller soot particles.

General Comments:

The authors took 40-nm and 80-nm particles to explore volatility of nucleation-mode soot particles. The VTDMA measurement show that the particles in nucleation mode (represented by 40-nm particles) had strong volatility and a high degree of internal mixing with shrink factor of ~0.4, meaning that the residual particle size after heating was ~16 nm. These residual materials after heating at 300 degree for 40-nm particles are dominated by extremely low-volatile components rather than soot, taking into account that a carbon spherule of soot agglomerates has size of 15-30 nm. The authors claimed that the number concentration of 40-nm and 80-nm particles increased quickly due to the influence of new particle formation (NPF) events. Previous studies (e.g., Ehn et al., 2014) have demonstrated that the importance of extremely low-volatile organic components for the initial growth of new formed particles. These extremely low-volatile organic

components remain in the particle phase after heating at 300 degree. How the authors to demonstrate that the residual materials after heating at 300 degree for 40-nm particles are soot rather than extremely low-volatile organic components?

Specific comments:

- Abstract: I don't think the May, September and October with temperatures in the range of 15-30 degrees are cold months.
- Introduction (Page 3/Lines 61-62): The authors stated that "However, studies on the mixing state of BC or soot particles in the actual atmosphere are few due to limited observations." To my knowledge, there have been many field measurements to investigate the mixing state of ambient BC particles using a single-particle soot photometer (SP2) and a soot particle aerosol mass spectrometer (SP-AMS) in recent years.
- 2.2 Measuring BC: The raw data of AE33 measurement have a large uncertainty due to filter-loading and multiple-scattering effects. However, the authors did not make any corrections for measurement data.
- Page 7/Line 188ï¼□Average temperatures in warm (June, July, and August) and cold (May, September, and October) months only have a difference of ~6 degree. The authors should reconsider classification criteria to discuss monthly variations.
- Page 8/Lines 218-219: The similar changes in concentrations of BC and PM can not suggest the non-trivial role of BC in the formation processes of aerosol pollution. Both concentrations of BC and PM strongly depend on planetary boundary layer height.
- Page 9/Lines 246: should be "non-volatile"
- Page 12/Lines 326-328: There are only two sizes in nucleation mode. The authors made conclusion that the volatility of nucleation-mode soot particles became larger with increasing particle size, which is not solid.
- Figure 10: The coating depth and temperature have a poor correlation (R2=0.03-0.04), which can not support that coating depth depends on temperature as discussed by the authors.
- Page 17/Lines 441-442: Which measurement results can demonstrate enhanced nocturnal liquid chemical reactions?