Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-370-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aging and hygroscopicity variation of black carbon particles in Beijing measured by a quasi-atmospheric aerosol evolution study (QUALITY) chamber" *by* Jianfei Peng et al.

Anonymous Referee #2

Received and published: 12 June 2017

The manuscript investigated the changes in the hygroscopicity of elemental carbon (EC) aerosol during aging in QUALITY chamber where the gaseous species in ambient air constantly diffused into the reaction chamber and products from their photochemical reactions interacted with mono-dispersed EC seed particles. The variations in EC particle size, mass, chemical composition, hygroscopicity and CCN properties were monitored throughout the aging processes. This study provides a unique perspective among chamber studies because the EC seed aerosol was exposed to photochemical oxidation products from an environment that closely mimics the actual ambient air.

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Discussion paper

Evaluating the hygroscopicity of EC has been a challenge for the atmospheric sciences research community due to the complex morphology changes. Following the method of using mono-dispersed seed aerosol (Qiu et al. ES&T, 2012 and Khalizov et al. ES&T, 2013), this study provided new insights into this complex research problem. The current manuscript also nicely supplements a recent publication from the same authors (Peng et al. PNAS, 2016) by providing detailed evaluation of the the QUALITY chamber. The characterization of the QUALITY chamber experiments appeared to be thorough and the results appeared to be reliable. The topic is relevant to the scope of the journal of Atmospheric Chemistry and Physics and should be considered for publication.

A few comments are provided to facilitate the further improvement of the manuscript: (1) Recent studies showed (for example, Chen et al. Geophys. Res. Lett. 2016, 43, 11080) that the morphology of nascent EC particles can be highly sensitive to even a small change in the organic coating on the primary spheres. As a result, it is prudent to provide experimental data to show that all the EC seed particles started with similar morphology and chemical composition. What was the thickness (or weight percent) of volatile organics in the seed particles at the beginning of each chamber aging experiment? (2) Evaluating the hygroscopic changes of EC has been a challenge. It has been proposed (for example, Qiu et al. ES&T, 2012) that the hygroscopicity of the coating materials can be measured or estimated to reflect the real hygroscopic growth of the EC particles. The authors may consider incorporating such approach to covert the apparent HGF into the real HGF. Furthermore, I wonder if similar approach can be developed for the CCN data to estimate the real κ values of aged EC particles. (3) What was the final size of the new particles from nucleation in the chamber? It could be a concern if the nucleation in the chamber was fast and the new particles grew too fast into the size range of the aged soot particles and hence interfere with the property measurements.

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