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Atmospheric Measurement Techniques Discussions

Interactive comment on "Sub 3 nm particle size and composition dependent response of a nano-CPC battery" *by* J. Kangasluoma et al.

Anonymous Referee #2

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The manuscript "Sub 3 nm particle size and composition dependent response of a nano-CPC battery", by Kangasluoma and co-authors characterizes working fluid dependent counting efficiencies of various CPCs in the particle size range below 3 nm. To this end, the authors use all kinds of laboratory generated seed particles to test the response of three laminar flow CPCs and one turbulent mixing type CPC. Working fluids used included water, butanol and diethylen glycol (DEG). Emphasis was put on a comprehensive set of seeds representing most aspects of atmospherically relevant particle properties, ranging from water soluble salts via metallic particles and flame products to purely organic samples. Even well-defined mixtures of particles generated from the mixing of controlled flows of two independent particle generators were investigated. The chemical composition and hence the purity/degree of contamination of the

particles was verified by a high resolution API-TOF mass spectrometer. The results show that the obtained counting efficiencies depend largely on the seed properties in this size range and on the charge state. In principle, I think this work fits well within the scopes of Atmos. Meas. Technol. and should be considered for publication. Still, to improve clarity several modifications and corrections as listed below are needed before this manuscript can finally be accepted.

General comments: I think the term nano-CPC battery is somewhat misleading as its operation is quite different from the "regular" CPC battery. In this sense I would recommend explaining in more detail how the nano-CPC battery differs from the CPC battery. Otherwise it sounds more like a CPC intercomparison than the characterization of a new set-up. For instance, based on this study the nano-CPC battery requires a DMA because there hasn't been any characterization of neutral particles. Also, I have not quite figured out what is the benefit of using the PSM in this set-up when all other instruments are laminar flow based and the DEG-CPC is part of the battery anyhow. Some more detailed explanations would be desirable.

Page 8857, line 14: reference to the description of the TDCIMS is better done with the following reference: Voisin, D., et al., Aerosol Sci. Technol. 37, 471 (2003).

Page 8859, line 22: . . .aerosols AND THEIR GENERATION METHODS are listed in Table 2.

Page 8860, line 24: please explain to the reader why charger generated negative ions are not an issue here. I assume it is the different mobility size compared to the (larger) positive ions but it should be made clear.

Page 8861, lines 3,4: How did the authors generate those particles? It's shown in table 2, but it would also be good to have some details on the different particle generation techniques in the text. See also my comment above regarding page 8859, line 22.

Page 8862, lines 13-18: please reformulate. Is it 10 Lpm through each generator (as

suggested on line 13), or is it 10 Lpm total flow? Lines 17, 18 on this page state: “flow rate settings of the ammonium sulphate and tungsten oxide generators, respectively: 10 and 0 LPM,. . . According to Figure 1 (lower panel) it should be 20 Lpm total flow.

Page 8863, line 4: move sentence “The whole. . .is presented in Fig. 1.” somewhere to the beginning of this section.

Page 8866, lines 6-8: please reformulate. Figs. 3 and 4 show different things. Only Fig. 4 shows ratios above unity.

Page 8867, line 19: How were the d50 diameters determined? From a fit function?

Page 8868-8869, section 3.3 “Aerosol mixing state”: the authors claim firmly that the resulting particles are internally mixed. How do they know? Is there a definition for internal/external mixture in the size range of 1-2 nm? To me it sounds more like externally mixed clusters as would be supported by the statement on page 8869, lines 17,18: “tungsten oxide clusters ATTACHED with persulphate”. Unless there is good reason to believe those clusters are internally mixed I would be more cautious with such terminology.

Page 8869, line 20: Figure 6 consists of an upper and a lower panel. There is no “a” and “b”. Change text or label Figure 6 accordingly.

Page 8870, line 1: same comment as previous.

Page 8870, line 5: To me, Figure 6 (lower panel) is lacking a “clear bump”. Those data are experimental data with some uncertainty. Please add symbols at corresponding flow rates indicating experimental error. Otherwise the lines are meaningless.

Page 8870, line 7: similar comment as previous: sorry, I do not see a decreasing trend for the 3786 with increasing tungsten oxide flow rate.

Page 8870, line 25: . . .Fig. 6, lower panel,. . .

Page 8871, lines 17-19: The conclusion that the results obtained justify the use of the

nano-CPC battery in the field contradicts the experimental condition of close-to-zero relative humidity (page 8861, lines 20-23).

Page 8880, Table 3: activation efficiencies of THABr monomer and dimer are given in %. I am missing a factor 100 though. I guess it should be more like 0.1 to 3%, shouldn’t it?

Page 8882, Figure 1: This figure looks rather like a drawing in a lab book than a figure for presentation in a scientific paper. Remove the text in between the two panels as it appears in the figure caption anyhow. Please revise.

Page 8883, figure caption: please add “(top)”, “(middle)” and “(bottom)” at respective places.

Page 8885: add “negative” and “positive” to figures as done in Fig. 3.

Edits:

Page 8860, line 11: . . .flow of the counters was. . .

Line 14: . . .nucleate. . .

Line 15: . . .(Peinke et al., 2006). . .

Page 8862, line 20: delete “again”

Page 8865, line 23: . . .interpretation. . .

Page 8866, line 1: delete one “interpret”

Page 8868, line 12: is it: “ . . .we do now know. . .” or “. . .we do not know. . .”?

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 8855, 2013.