

## ***Interactive comment on “Effects of Temperature, Pressure, and Carrier Gases on the Performance of an Aerosol Particle Mass Analyser” by Ta-Chih Hsiao et al.***

### **Anonymous Referee #1**

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Review of “Effects of Temperature, Pressure, and Carrier Gases on the Performance of an Aerosol Particle Mass Analyser” by Hsiao et al.

The authors reported evaluations of temperature, pressure, and carrier gas on the performance of a commercially available aerosol particle mass analyser (APM). The effects of the first two parameters (temperature and pressure) were mainly evaluated through theoretical calculation of the transfer function of APM, while effects of carrier gases (air, O<sub>2</sub> and CO<sub>2</sub>) were experimentally evaluated with DMA pre-selected 50-nm and 100-nm PSL spheres. Results suggested that the mass detection limit of particles can be as low as 10<sup>-2</sup> fg, and can be further extended to low values with

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other carrier gases such as hydrogen or with a lower operation pressure down to 80 kPa. The treatment of the theoretical calculation of the transfer function is rigorous, and experiments were well designed and performed. The writing of the manuscript is clear, and the study is within the scope of AMT. However, I have concerns, some of which appeared in the initial review, that the authors are over-interpreting their results and ignoring a few other studies of the same sort. These concerns are detailed below in Major Comments, while a few editorial suggestions are listed as Minor Comments. I suggest publication of this manuscript in AMT after the authors address them in the revised manuscript.

#### Major Comments:

1. While first stating the importance of the DMA-APM system in measuring atmospheric particle mass and effective density, the authors might be a bit over-emphasizing the “low” mass detection limits using hydrogen as the carrier gas and operating under 80-kPa condition. We do not have either of these often in the atmosphere (at least in the lower portion). It is good to characterize the DMA-APM system under those conditions, but it is a bit misleading (giving an impression that 10<sup>-4</sup> fg is easily achieved in ambient measurements) to state those numbers in the abstract. And some of them were from theoretical calculation instead of direct measurement (see below in Major Comment #2).
2. While the authors stated throughout the manuscript (and the title) that temperature, pressure, and carrier gases were evaluated for the APM performance, most of them (at least for temperature and pressure) were from theoretical calculation. I suggest the authors stating this caveat explicitly in their abstract/conclusion, in order not to mislead readers that temperature and pressure were also evaluated experimentally.
3. Kuwata et al. (ES&T, 2012; AS&T, 2015) used DMA-APM to study particle (specifically SOA) density (ES&T, 2012) and developed equations to characterize the DMA-APM system (AS&T, 2015). It is highly suggested that this manuscript is put in the

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context of those previous studies with comparison and discussion.

4. The authors mentioned that viscosity and density of the carrier gases might affect the classification capability of APM (page 7, line 6). While viscosity was included in their theoretical treatment, is it possible to include different densities of those carrier gases tested? These three gases (air, O<sub>2</sub>, and CO<sub>2</sub>) have quite different molecular weights too. Is that going to affect the classification capability of APM as well?

5. As the authors stated quite frequently the usefulness of using the DMA-APM system to measure effective density, what is the measured density of PSL spheres when compared to reported values?

Minor Comments:

1. Page 2, line 15: "(Ehara et al., 1996)" to "Ehara et al. (1996)".
2. Page 2, line 22: "the past decade" to "the past decades". You cited papers in as early as 2002.
3. Page 4, line 6: "defined by(Ehara et al., 1996)" should be "defined by Ehara et al. (1996)".
4. Page 4, line 25: "low molecular weight" to "low-molecular-weight".
5. Page 6, line 2: "APM C<sub>N</sub>-V spectra". Is "C<sub>N</sub>" defined?
6. Page 6, line 27: "peak voltage is indicate" to "peak voltage is indicated".
7. Page 7, line 31: "by an approximate order of" to "to approximately"?
8. Page 13, Figure 5: better to separate this figure into two panels (say for 50-nm and 100-nm PSL), and join the symbol with lines. It is very difficult to tell which one is which in the current form. Also I am not sure if this Penetration-Voltage plot can be called "experimental transfer function".
9. Page 14, Figure 6: although symbols and lines were defined in the text, it would be

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better to put the legends here in the figure for readers to follow easily.

10. Page 15, Figure 7: this figure has different appearance in tick labels and legends (too small to see) compared to other figures. Suggest to change those labels to a larger font size.

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