

Atmos. Meas. Tech. Discuss., referee comment RC3
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Comment on amt-2021-172

Anonymous Referee #3

Referee comment on "Detection of Sulfur Dioxide by Broadband Cavity Enhanced Absorption Spectroscopy (BBCEAS)" by Ryan Thalman et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-172-RC3>, 2021

Thalman and Hansen describe a promising new broadband cavity-enhanced absorption spectrometer for quantification of SO₂ in air in the 305-312 nm region. Overall, I think this paper was perhaps submitted prematurely as some needed experimental work and a (critical) discussion of the results were absent. In my opinion, this paper should be rejected at this time, but I would like to see the authors submit a revised version once more data have been collected and the manuscript has been revised.

Major/general comments:

The authors present what looks like a promising instrument, but the manuscript is lacking a few key elements:

- (1) Since the scope of this journal is on atmospheric measurement techniques, I would have expected to see some sample ambient air measurements with this new instrument, in parallel to a trusted reference method. Are there interferences in ambient air, for example? The authors state that other species were not included in the fit, which may be OK for a laboratory comparison, but does this approach hold up for ambient air measurements?
- (2) What can the authors say about the stability of this instrument? The LED manufacturer shows a stability data over a 2,000-hour life span on their web site - does this imply that the LED will have to be replaced after 3 months of use?
- (3) A critical discussion of the results needs to be added. How does the performance of this instrument compare to other instruments, including commercially available ones? Is it better, worse, and why? What was the dynamic range, response time, power requirements, size compared to (many) other instruments out there? What has this paper contributed to the problem of SO₂ measurements? Does this new instrument provide a faster, more sensitive, or more accurate data? What needs to be done to improve matters further? Are any parts of the design advantageous or trouble (such as the 3D-printed cages, or the materials used for printing)? Since two spectrometers were evaluated, what are the advantages of the Avantes over the Andor (and vice versa), and are the observations consistent with what might have expected from the manufacturer

specs?

Specific comments:

line 3 LOD is stated as 3.6 ppbv on line 122, but 0.6 ppbv on line 3.

lines 20 Consider consolidating all this information in a Table.

line 53 3D-printed cages are not very common. Please discuss (in the discussion section) pros and cons and the performance (do they last?) of the printed cages.

line 57 "The LED was temperature controlled with a Peltier cooler". More detail is needed here. How was the LED mounted/secured? How/where was the Peltier element attached? What model Peltier element was used? How/where was the temperature measured?

line 64 "260 - 820 nm" This huge range seems to be mismatch for this application - consider exchanging the grating in future.

line 67-69 "The Avantes spectrometer was not ideal" - consider moving this sentence to the discussion section.

pg 3 / Figure 2 - Panel A is of insufficient resolution.

line 72 "The material of choice was changed for various structural elements depending on the structural and design requirement." Please provide more details here. What are the structural and design requirements? Changed how?

line 94-95 This is not a grammatically correct sentence.

line 102 how were temperature and pressure measured?

line 104 What was the manufacturer-specified uncertainty of this standard?

line 120 Strike duplicate author names (twice); replace "rather that" with "rather than"

line 134 "Known interferences ... are avoided using the BBCEAS method". Please provide data to show that this is indeed the case.

line 136 "Improvements" - is this future work?

line 150 "Data for the experiments and figures are available in the Supplementary Material". There was no supplementary material uploaded.