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Interactive comment on “Technical Note: Aeolian dust proxies produce visible luminescence upon intense laser-illumination that results from incandescence of internally mixed carbon” by L. Ma et al.

Anonymous Referee #1

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This paper describes luminescence from mineral dust proxies upon 532 and/or 1064 nm laser illumination. Based on the spectral measurement of the luminescence from the tested materials, detected signals were attributed to the blackbody radiation (i.e., incandescence) from the materials heated to $\sim 4000\text{K}$, which is as high as the color temperature of soot typically found in laser-induced-incandescence (LII) process. Incandescence signal per unit mass concentration of tested materials (SI) is used as an indicator for the soot content in the sample. The values of SI for dust mimics are much smaller than that for pure soot materials, indicating that the dust mimics contain a very

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small amount of soot (internally mixed). The note can provide the important result to suggest the usefulness of the LII technique to detect the soot-containing particles in which soot material is a very minor constituent. The contents in this note are appropriate for Atmospheric Measurement Technology, but some points raised in the following have to be addressed before acceptance.

General comments

1. Structure of the text Restructuring the manuscript especially for clarifying the robust experimental results and speculations made by the authors is strongly recommended for better readability. The section 3, “Results and discussion”, should be separated into two parts (i.e., “Results” and “Discussion”). Some parts of the section 3 include experimental descriptions (e.g., P5182 Line 20-22), which should be given in the section 2 “Methods”. Please see “Minor comments” in the following for the details of each sentence.

2. Composition analysis of the dust mimics used in the experiments A lack of the composition of the dust mimics results in the uncertainty to identify the source of the luminescence. How do you consider the possibility of the co-existence of the light absorbing materials with a similar thermal properties to soot (e.g., sublimation point)? Some metals can absorb the light at the same wavelength (1064 nm) and have similar thermal properties. In order to clarify the source of incandescence, the authors should conduct composition analysis of the dust mimics tested in this study. Another concern is the thermal transfer from heated soot to surrounding dust materials. This contributes the cooling of soot on the particle. The mass of co-existing materials (i.e. dust in this study) is much larger than that of soot. LII of soot on dust particles should be different from that from submicron soot-containing particles, which has been well investigated in a lot of previous studies (e.g., Michelson, 2003; Stephens et al. 2003; Moteki et al. 2007). How do the authors consider the effect of the amount of surrounding materials on the LII phenomena? The heating-induced fragmentation of the soot-containing dust particles can cause changes in the size distribution and number concentration by

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lazing (Figure 6). Therefore, the fragmented materials can be dust materials. Electro-microscopic and composition (for example, using X-ray) analysis for such fragmented particles is also helpful to verify the similarity of the results in this study with Michelson et al. (2007). See also minor comment [12] in the following.

Minor comments

[1] P5175 Line1-2 Some references for the laser-induced-incandescence (LII) technique to detect BC containing particles are described before this sentence. In all of those studies, a single particle soot photometer (SP2), in which the “CW” intra-cavity laser is implemented, has been used as a detector of the BC-containing particles. Please correct this sentence and add some appropriate references to the previous studies for the similar LII BC detection techniques used in this study.

[2] P5178 Line4-6 The experimental description is not needed in the section of “Results and discussion”. Please move this sentence to the section of “Method”.

[3] P5177 Line 22-24 Why did the authors use the combined beam for this experiment? Please describe the reason to use the different experimental setup (from other experiments).

[4] P5178 Line13-14 This sentence should be included in the figure caption. Please remove it from the main text.

[5] P5178 Line19-24 The descriptions of the measured luminescence signal from the dust mimics should be moved to the next section (3.2) to directly connect the signal detection with the quantification of the concentration of BC (i.e., Quantitative characteristics of emission~).

[6] P5180 Line 27 “inactive” Inactive to what?

[7] P5181 Line 3 “a per mass basis” This is actually wrong and misleading. The authors did not use an aerosol particle mass analyzer or Centrifugal Particle Mass Analyzer for classifying the mass per particle of dust particles in the experiment. Please correct

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this, for example, to “per unit mass concentration”.

[8] P5181 Line 16-18 Please add appropriate references to this sentence.

[9] P5181 L23-P5182L2 These sentences include highly speculative discussions. As suggested in “General comments”, such descriptions should be moved into an independent section (ideally separated “Discussion” section).

[10] P5182 L5 “the combined 532 + 1064 nm beam” Why did the authors use the combined beam for this experiment? Please describe the reason. (Same as P5177 Line 22-24)

[11] P5182 L 20-22 The description for the experimental setup should be given in the section of “Method”. Please remove this sentence from the section of “Results and discussion”.

[12] P5182 L 23-24 Changes in the size distribution of particles irradiated by the intense laser (found in Figure 6) are similar to that given in Michelson et al. (2007). In this study, a large fraction of the BC-containing particles consists of dust materials, which is critically different from the case given in Michelson et al. (i.e., pure soot material). It is difficult to clarify the similarity between the results in this study and Michelson et al., unless the author investigates the composition of these fragments. One possible way to verify this point is collecting size-dependently particles (smaller than 100 nm) after lasing, observing fragmented tiny particles by an electro-microcopy, and analyzing these by EDS.

References

Michelson, H. A. (2003), Understanding and predicting the temporal response of laser-induced incandescence from carbonaceous particles, *J. Chem. Phys.*, 118(15), 7012-7045. Michelson, H. A., Tivanski, A. V., Gilles, M. K., van Poppel, L. H., Dansson, M. A., and Buseck, P. R. (2007), Particle formation from pulsed laser irradiation of soot aggregates studied with a scanning mobility particle sizer, a transmission electron

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