

Reply to the comments by Prof. Dantong LIU on manuscript Entitled "Dynamic shape factor and mixing state of refractory black carbon particles in winter in Beijing using an AAC-DMA-SP2 tandem system"

We thank Dr. Liu very much for providing insight comment on our manuscript. I would like to response the comments one by one as follows:

1. I would suggest to give a distribution of χ for each period, given you have scanned mobility diameter for a fixed aerodynamic diameter.

Reply: We would like to follow the reviewer's comments to add the discussion on the χ distribution for different pollution period.

2. For each χ , you could use the SP2 incandescence signal to separate the BC and non- BC containing particle, then you could move the focus to BC-containing particle, but this connection is missing right now.

Reply: We consent to the suggestion that more discussion focusing on variation of χ for the rBC-containing particles is necessary for better understanding the effect of rBC core on the morphological variability of whole particles.

3. I would like to suggest to reduce discussion about the core-shell ratio as you derived from calculated diameter because you have made a lot of effort to describe the particle morphology but simply using this will then turn the story back, which is not what you expected I believe. You could try if you could get the particle mass or volume, then combing with the refractory BC mass from the SP2 to see how the possible particle morphology could be in terms of how the coating and rBC had been combined.

Reply: In the revised manuscript, we will reduce the discussion on the S/C ratio and strength discussion on the effect of mass ratio of rBC-containing particles. It will give more useful information on the absorption enhancement capacity. We will do single-particle scattering cross-section analysis derived from both core-shell model and direction observation that proposed in literature (Liu, D. T., Whitehead, J., Alfarra, et al., Black-carbon absorption enhancement in the atmosphere determined by particle mixing state, Nat Geosci, 10, 184-U132, 10.1038/Ngeo2901, 2017.)

Further discussion is welcomed, please contact with me via panxiaole@mail.iap.ac.cn.