Reply to comments on “Reconsideration of surface tension and phase state effects on CCN activity based on the AFM measurement” by Xiong et al.

Reply to Anonymous Referee #2

Minor comments:

1) Authors revised the manuscript well by considering the most of the comments by the reviewers. The authors provided an excellent response to the major comment by reviewer #2. However, the content is not reflected to the revised manuscript. It should make sense to add the contents to the revised manuscript unless the authors have a significant concern about it. I believe that the revised manuscript will meet the criteria of the journal after adding the content to the manuscript.

Response: We really appreciate the constructive comments and suggestions raised by the reviewer. As suggested, we have added the response of the major comment to our revised manuscript.

Addition:

L273: In order to quantitively connect surface tension and measured $\kappa_{CCN}$, we used the solubility-involved Köhler model which was introduced by Petters and Kreidenweis (2008), to investigate sensitivity of the measured $\kappa_{CCN}$ values on the assumed value of surface tension for inorganic salts/OA systems. As shown in Fig. 7a,
$\kappa_{\text{CCN}}$ of NaCl/OA with 60%, 75% and 89% OVF derived from solubility-involved Köhler model with water surface tension were 0.515, 0.324 and 0.145 (circles). These values underpredict measured $\kappa_{\text{CCN}}$ (0.688, 0.485 and 0.296, triangles). However, if modeled $\kappa_{\text{CCN}}$ values fit the measured values, the corresponding surface tensions should reduce to 65.4 mN m$^{-1}$ (60% OVF), 62.7 mN m$^{-1}$ (75% OVF), 56.7 mN m$^{-1}$ (89% OVF). Similar results were also found for AS/OA systems (Fig. 7b). In Fig. 7c, fitted surface tension showed good linear relation with measured surface tensions (slope and $R^2$ were 1.09 and 0.71). Therefore, our results could provide a quantitative way to predict $\kappa_{\text{CCN}}$ values of inorganic salts/OA based on solubility-involved Köhler model, by using their measured surface tensions results under high RH. This quantitative method should be tested for more chemical systems in the future.
Fig. 7 $\kappa_{CCN}$ vs. assumed surface tension for (a) NaCl/OA and (b) AS/OA systems according to solubility-involved Köhler model presented by Petters and Kreidenweis (2008). The triangles and circles in (a) and (b) represent the measured $\kappa_{CCN}$ and predict $\kappa_{CCN}$ by solubility-involved Köhler model. Closure between fitted surface tensions and measured surface tensions (c). $\sigma_w$ represents water surface tension (72 mN m$^{-1}$).

Reference