*I am not convinced that the lone sentence "With the resolved fields, MATLAB was then used to solve the particle growth equations (Eqs. 5–9)." gives readers the required clarity of what was done. I consider a proper paragraph describing the logic would be appropriate.

Reply:

Thank you for the comment. Accordingly, we provided a detailed description on the methodology of the computation:

In the revised manuscript (Line 207-220), we clarify that COMSOL was first used to obtain steady-state velocity, temperature, and vapor-concentration fields in the sMCPC. Data of spatially resolved fields was then transferred to MATLAB to obtain local field data required in the calculation of particle growth and trajectory at each time step. Eqs (5–9) were solved simultaneously to update the particle diameter and droplet temperature. We further clarified that MATLAB was not used to release and track an ensemble of individual particles. Instead, the inlet particle population was represented by a continuous radial distribution. The resulting activation boundary was combined with the local particle number flux, $w(r)N(r)$, and the counting efficiency was calculated by the flux-weighted integration given in Eq. (3).

*I believe the approach the authors are taking does not take into account the diffusion of particles along advective streamlines. The diffusion of particles will affect their trajectories and growth. I would like to see this mentioned, discussed, or - in the best case - constrained from a sensitivity study.

Reply:

Thank you for the comment. Indeed, the particle diffusion in the convective direction is neglected in our calculation. Accordingly, we included a paragraph (Line 222-229) to explain why it was neglected in our calculation: “Note that the particle Brownian diffusion in the convective direction was neglected when calculating the advective transport paths. The above assumption was assessed by comparing the characteristic diffusion velocity, $U_{\mathrm{diff}} = D_B/L$, with the axial advective velocity U. Over the

investigated particle-size range ($\leqslant$100 nm) and operating conditions, $U_{\mathrm{diff}}/U \ll 10^{-4}$, indicating that particle transport is dominated by advection. Moreover, the particle-laden flow entering the mixing chamber (along the centerline) is immediately exposed to the vapor-rich flow (introduced through a series of small holes arranged annularly), thereby keeping particles away from the near-wall region. The effect of particle Brownian diffusion along the transport paths was considered limited.

*I also invite the authors to include their rationale for not doing the modelling in COMSOL. I somewhat disagree with the statement in the direct reply to my comment that the system is fully coupled (i.e., the particle inertia can be assumed to not affect the flow fields, the (macroscopic) temperature and vapor concentrations can be assumed to be not be affected by condensation), and that a coupled model would need to be run.

Reply:

Thank you for this constructive comment. We agree that the expression "fully coupled" may mislead readers. Accordingly, we included a paragraph to detail the status of coupling in the revised manuscript (Line 231-236): "The present modeling is partially coupled: only the flow, temperature and vapor fields were solved by COMSOL in a coupled manner, whereas the COMSOL-resolved fields were not updated due to the vapor consumption and latent heat release during the calculation of particle transport and growth. It is because low concentration of particles is considered in this study. Under the above assumption, the particle momentum loading and condensation-induced source terms are expected to have minor effect on the macroscopic flow, temperature, and vapor fields".

The use of MATLAB for the particle-growth calculation is because it effectively enables the coupling of particle-state equations and size-dependent correction factors during the repeated calculation of field data interpolation, particle diameter, droplet temperature, Kelvin correction, vapor diffusion properties, and non-continuum correction factors when compared to perform the same calculation in COMSOL. Meanwhile MATLAB provides a transparent and computationally efficient means of

integrating these coupled particle-state equations and performing repeated activation-efficiency calculations using the previously resolved COMSOL fields. Implementing the same procedure in COMSOL would add considerable implementation and computational overhead. (Line 238-242)

The revised text, in L207-242, now reads as follows:

The above equations require the temperature and vapor fields of working fluids in the flow channel of sMCPC for the calculation of particle activation and condensational growth. An axisymmetric COMSOL model was therefore used to obtain the steady-state velocity, temperature, and vapor fields in the mixing chamber and growth tube of the sMCPC. Once calculated by COMSOL Multiphysics, the filed data was transferred to MATLAB for calculating the particle activation and growth. Local temperature and vapor partial pressure were obtained from these fields at each time step for the particle trajectory and growth calculation.

The vapor diffusion coefficient and the non-continuum mass- and heat-transfer corrections were then evaluated, and Eqs. (5-9) were solved simultaneously to update the particle diameter and droplet temperature. Instead of releasing and tracking an ensemble of individual particles, the particle population at the inlet was represented by a continuous radial distribution. The calculated activation boundary was subsequently combined with the local particle number flux, $w(r)N(r)$, and the counting efficiency was obtained through the flux-weighted integration given in Eq. (3).

Note that the particle Brownian diffusion in the convective direction was neglected when calculating the advective transport paths. The above assumption was assessed by comparing the characteristic diffusion velocity, $U_{\mathrm{diff}} = D_B/L$, with the axial advective velocity U. Over the investigated particle-size range ($\leqslant 100$ nm) and operating conditions, $U_{\mathrm{diff}}/U \ll 10^{-4}$, indicating that particle transport is dominated by

advection. Moreover, the particle-laden flow entering the mixing chamber (along the centerline) is immediately exposed to the vapor-rich flow (introduced through a series of small holes arranged annularly), thereby keeping particles away from the near-wall region. The effect of particle Brownian diffusion along the transport paths was considered limited.

The present modeling is partially coupled: only the flow, temperature and vapor fields were solved by COMSOL in a coupled manner, whereas the COMSOL-resolved fields were not updated due to the vapor consumption and latent heat release during the calculation of particle transport and growth. It is because low concentration of particles is considered in this study. Under the above assumption, the particle momentum loading and condensation-induced source terms are expected to have minor effect on the macroscopic flow, temperature, and vapor fields.

Note that the use of MATLAB for the particle-growth calculation is because it effectively enables the coupling of particle equations and size-dependent correction factors (i.e., particle diameter, droplet temperature, Kelvin correction, vapor diffusion properties, and non-continuum correction factors) as well as field data interpolation during the repetitive calculation of activation-efficiency (compared to performing the same calculation in COMSOL).