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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Laboratory studies ofH_2SO_4/H_2O binary homogeneous nucleation from the SO_2+OH reaction: evaluation of the experimental setup and preliminary results" *by* L.-H. Young et al.

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Response to the Three Reviews on "Laboratory Studies of H2SO4/H2O Binary Homogeneous Nucleation from the SO2 + OH Reaction: Evaluation of the Experimental Setup and Preliminary Data" by L.-H. Young et al.

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We thank the three anonymous reviewers for insightful comments that helped improve our manuscript significantly. Below I listed a summary of our major revisions. Our point by point responses to each review are included in separate files. I have also enclosed

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Interactive Discussion
Discussion Paper

the revised manuscript for the reviewers.

Major revisions:

1. CPC measurement stability (Section 2.3): We have included a detailed discussion on the stability of particle measurements. Usually it took 3 hours to completely stabilize the system when using water-UCPC and the initial concentrations were approximately a factor of 5 higher than that after a steady state has been achieved. For nucleation rates reported here, this factor of 5 has been taken into account.

2. Nucleation zone (Section 3.3): In order to estimate the nucleation zone, we have conducted numerical simulations of aerosol nucleation as a function of axial axis position of the nucleation reactor based on the nucleation and condensation growth processes and from the measured aerosol size distributions and [H2SO4]. These calculations show that the nucleation zone is within about 40 cm (a half of the nucleation tube length). This factor of 2 (residence time vs nucleation time) has been taken into account for nucleation rates in the revised manuscript. These simulations were made by Jeff Pierce (co-author now).

3. Growth rate calculations (Section 5.3): We also provide a detailed discussion of growth rates calculated with three different methods using the measured aerosol sizes, residence time and the initial [H2SO4] [calculated from the residual [H2SO4] and wall loss factors (WLFs)]. These growth rate calculations were made by Heikki Junninen and Markku Kulmala (new co-authors).

4. Wall loss factors (WLFs) and [H2SO4] (Sections 3.1 and 3.2 and Table 2): We performed simultaneous measurements of [H2SO4] at the beginning and at the end of the nucleation reactor with two chemical ionization mass spectrometers (CIMSs) and found that WLFs, calculated by assuming sulfuric acid wall loss is diffusion limited, are consistent with observations (Section 3.2). Also, these initial

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[H2SO4] were within the same order as the [OH] measured from the water vapor UV photolysis experiments within experimental conditions, confirming that our assumption that when [SO2] $>>$ [OH], the initial [H2SO4] = [OH] is valid (Section 2.1).

5. Figures were revised as a function of [H2SO4] (as opposed to as a function of time previously). Also for [H2SO4], we have also included WLFs, so that we can estimate the initial [H2SO4] from the method mentioned above.

6. Experimental conditions (Table 2 and Figure 6): We have revised Table 2 to show the detailed experimental conditions. We also included Figure 6 to show how aerosol precursors evolve as a function of time in the nucleation reactor.

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