

Interactive comment on “Homogeneous nucleation of sulfuric acid and water mixture: experimental setup and first results” by D. Brus et al.

D. Brus et al.

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We thank to reviewers for constructive review of our manuscript, we do also appreciate reviewers' suggestions to improve the manuscript.

Report of referee #2

Referee#2:

1) Use “molecules cm(-3)” instead of “molecules in cm(3)”, etc. throughout in the text and figures. Apply for sulphate ions the commonly used formula/notation in chemical literature.

Authors:

This will be corrected in new version of the manuscript.

Referee#2:

2) P.23877, line 25: Wyslouzil et al.(1991) observed an increase of the nucleation rate of 2 – 4 orders of magnitude as a result of increasing the temperature by 5 K, not decreasing! See fig.11 in the original paper.

Authors:

Yes the expression is inaccurate. In the original paper of Wyslouzil et al. (1991) the temperature dependent data are presented in plot of J vs. relative acidity (RA). When we recalculate RA to [H₂SO₄] the isotherms change their place, see included figure 1. After recalculation the temperature dependency (increase of nucleation rate with decreasing temperature) is not very clear, especially the position of isotherm 30°C.

In new version of manuscript we will change the sentence on p.23877, line 25 to following:

Only a narrow temperature range of 20 – 30 °C was utilized in measurements by Wyslouzil et al. (1991), the plot of nucleation rate vs. relative acidity in there is showing that 5 °C decrease in nucleation temperature leads to a decrease in nucleation rate from two to four orders in magnitude.

Referee#2:

3) P.23878, line 20: The filter is located downstream the furnace. Is the filter also held at furnace temperature? What is the dimension of the mixing unit? Is it surrounded with a thermo-jacked? What is the wall temperature? The filter is used to remove any residual particles after the heating zone at 470 K. What is the source of these particles? Are they produced in the high-temperature zone or do they arise from evaporation of liquid H₂SO₄ and survived the heated zone?

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Authors:

Teflon filter is placed on the perforated Teflon support pad just after the furnace and before the entrance to mixing unit. The exact location and the legend will be added in to figure 1 of the manuscript.

The temperature inside the furnace is usually ~ 470 K (~ 200 °C). The declared maximum operating temperature of Teflon filter (MITEX Millipore $5.0\ \mu\text{m}$ LS) used is 260 °C.

Yes, the filter is used to remove residual particles from imperfect evaporation of liquid H_2SO_4 . There is no production of particles inside of furnace, when the source of sulfuric acid is off, or pure water is used, we obtain particle count close to zero. The filter itself helps us only to extend nucleation rates to lower values; the smaller background particle count is obtained.

The dimensions of the mixing unit are: O.D = 10 cm, I.D. = 7cm, length = 6 cm. It is whole made of Teflon. It is kept at room temperature and it is not insulated. This information will be added to manuscript, p. 23878, line 24, section: Experimental setup.

Referee#2:

4) P.23881, line 6: A 50% cut-off size of 2.18 nm is stated for a TSI 3025A counter using Ag particles for calibration. What kind of modification has been done? Originally, this counter has a 50% cut-off size of 3 nm. Some explanations would be helpful.

Authors:

The saturator temperature of the UCPC TSI 3025A was increased from nominal 37 °C up to 38 °C. Condenser temperature was decreased from nominal 10 °C down to 8 °C. At these new temperatures no homogeneous nucleation was observed inside the counter. This information will be added to manuscript, p. 23881, line 6.

Referee#2:

5) Fig.5: What are the corresponding H₂SO₄ concentrations for the 3 measurement series?

Authors:

RH 10% - 1.85×10^{10} [H₂SO₄] cm⁻³

RH 30% - 2.32×10^9 [H₂SO₄] cm⁻³

RH 50% - 5.01×10^9 [H₂SO₄] cm⁻³

This will be added to caption of figure 5.

Referee#2:

6) P.23881, line 12; Fig.6: Is it possible to describe the shape of N vs. t in this figure as a result of the sum of nucleation and wall loss? This should be discussed.

Authors:

Yes, it illustrates the competition between particle's grow and wall losses of sulfuric acid. The longer resident time the larger the particles can grow the better we can count them, on the other hand the less sulfuric acid is available due to wall losses. The resident times between 30 and 45 seconds were found to represent the optimum.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 23875, 2009.

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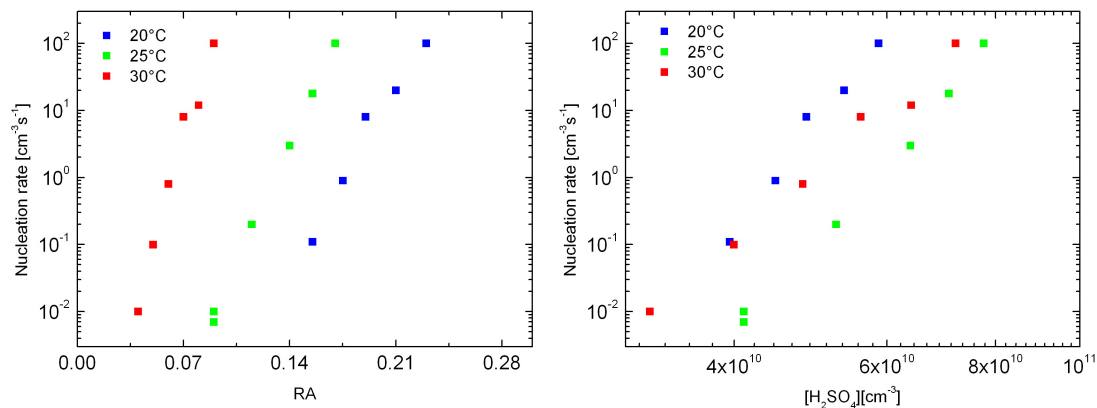


Fig. 1. Figure 1. Temperature dependent data of Wyslouzil et al. (1991).

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