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Interactive comment on "Formation of binary ion clusters from polar vapours: Effect of the dipole-charge interaction" *by* A. B. Nadykto and F. Yu

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Reply to Anonymous Referee # 2 (RC S1798)

Specific comments:

1. Comparison of the new model predictions with the available experimental data on the thermodynamics of binary clusters/particles would be useful indeed. However, at this point we found in the literature just few experimental studies concerning single-component the charged water clusters and sulfuric acid clusters. We would like to emphasize that the paper is focused on the thermodynamics of the binary clusters while the available experimental studies consider the single-component ones. On the other hand, in the case of for the single-component clusters the validity of the thermodynamical model applied in the present theory has likely been justified through the compari-

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son made in the recently published Nadykto et al. Chem.Phys. Lett. (Vol 382/1-2 pp 6-11, 2003). Running a binary model to get the results for the single-component cases is not practical because the models of the activity coefficients are valid over limited range of the ambient concentration of sulfuric acid (1E7-1E10 cm-3) and water vapour molecules(1E16-1E18 cm-3) and they fail at low (or very high) concentrations.

2.Ions influence the nucleation rates through both the reduction of change in the Gibbs free energy (evaporation) and enhancement of the growth rates (condensation). Hence, both effects have to be taken into account simultaneously. The contribution of the dipole-charge interaction to the growth kinetics may be very big (Nadykto &Yu. JGR, 108, 4717, (2003)) and, thus, the derivation of the nucleation rates is not as straightforward as it could be expected. We do not include the comparison of the changes in the Gibbs free energy in the paper purposely, because the presentation of the change in the Gibbs free energy only may make wrong impression about the charge effect on the nucleation rates. For the general audience difference in the change of the Gibbs free energy is associated directly with the difference in the nucleation rates that is not always the case. In the case studied in the paper, there does exist another important factor-enhancement of the condensational growth due to the dipoleŰcharge interaction that can affect strongly the nucleation rates. The complete theory of the nucleation rates requires corrections to both the Gibbs free energy and forward (condensation) rate, as well as the other related effects such as hydration and possibly change in the dielectrical properties of the condensed phase due to the electrical field applied, to be accounted for simultaneously. The work on the detailed model of the nucleation rates is in progress and we plan to publish it elsewhere.

3. The change in the Gibbs free energy associated with attachment of a monomer can be calculated from equation (7) in the revised paper.

Technical corrections: Corrected accordingly.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 4927, 2003.

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