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Discussions

Interactive comment on "Inversely modeling homogeneous H_2SO_4-H_2O nucleation rate in exhaust-related conditions" *by* Miska Olin et al.

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We thank the referee for careful reading of the manuscript and for giving detailed comments for clarifying it.

The referee firstly highlighted a sentence from our conclusions about the inappropriateness of pure binary H2SO4-H2O nucleation mechanism controlling particle formation in vehicle exhaust. As we already replied on the first referee's comment about this inappropriateness being the main conclusion of this study, it was not meant to be the main conclusion; instead, presenting the function for the binary H2SO4-H2O nucleation rate in exhaust-related conditions was meant. Neither was the finding of the other vapors or nucleation mechanisms participating in the particle formation process in vehicle ex-

haust the purpose of this study pointed out by the second referee. Instead, because even the physics behind the pure binary H2SO4-H2O nucleation mechanism is very uncertain to date, we focused on the nucleation rate of that, which could act as a starting point in examining the actual nucleation rate in the future. We see that, according to the comments from the both referees, this conclusion was highlighted too much in the manuscript to give the feeling of it being the main conclusion; nevertheless, we will rephrase it in the revised manuscript.

The current version of the manuscript did not tell clearly enough how the nucleation rate function resulted from this study can help in finding the actual nucleation mechanism occurring in vehicle exhaust. Firstly, performing inverse modeling with four free parameters (k, nsa, nw, and msa) to be fitted using CFD is already computationally very expensive. Thus, including other compounds, such as hydrocarbons, in the nucleation mechanism to be examined, will increase the computational expense significantly. Therefore, using the nucleation rate function, obtained in this study, as a starting point for a more complex nucleation rate function, will decrease the computational time in that kind of inverse modeling task. Secondly, the parameters of the obtained function for pure H2SO4-H2O nucleation rate can also give details on the currently poorly understood physics behind the pure H2SO4-H2O nucleation mechanism, for example, with the values of the nucleation exponents of 1.9 and 0.5 for H2SO4 and for H2O, respectively. The exponent of 1.9 for H2SO4 suggests that the nucleation can be driven by kinetic nucleation, which is the collisions between two H2SO4 molecules; however, the exponent of 0.5 for H2O does not match with any currently known nucleation mechanisms and raises thus new ideas for the nucleation theories. Finally, the obtained function can be used to improve the effect of traffic or power generation on particle concentrations in urban air. These clarifications will be added to the revised manuscript.

Other minor comments from the referee, such as reordering of the text describing different nucleation mechanisms, noting that the nucleation exponent is related to the number of nucleating molecules in the critical nuclei, and correcting and adding appropriate references, will be taken into account when preparing the revised manuscript.

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