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Interactive comment on "Homogeneous nucleation rates of nitric acid dihydrate (NAD) at simulated stratospheric conditions – Part II: Modelling" *by* O. Möhler et al.

Anonymous Referee #1

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General comment:

This paper derives a new parameterisation of the activation energy for homogeneous nucleation of nitric acid dihydrate (NAD) in supercooled liquid binary HNO3/H2O droplets, based on laboratory freezing experiments in the AIDA aerosol facility (described in a companion paper by Stetzer et al.). Homogeneous nucleation rates, based on the parameterized activation energies, have been applied by a microphysical model to simulate the NAD formation during the freezing experiments in the AIDA chamber. The model has also applied previously published parameterizations of volume and sur-

face proportional homogeneous freezing rates in comparison with the experimental data. The new experimental work and the derived parameterization of NAD freezing is important for our understanding of nitric acid hydrate formation in the stratosphere and the formation of solid type polar stratospheric clouds (PSC). Thereby the paper is of relevance for a broad atmospheric scientific community, and I can recommend it for publication in ACP after some revisions.

Specific comment:

I do find the discussion of the impact on solid type PSC formation somewhat weak. I would like to have seen some estimates, based on the derived homogeneous nucleation rates, of the production rates of hydrate particles (i.e. number of hydrate particles formed per hour per cm3 of air) under typical polar stratospheric conditions, i.e. in the presence of liquid aerosol particles. These production rates could be compared with estimated hydrate particle production rates from observations and/or used in model studies (e.g. Carslaw et al., JGR 107, D20, 2002; Voigt et al. 2005; Larsen et al., 2004). It is my guess that the new parameterisation of homogeneous nucleation will lead to insignificant hydrate particle production under typical Arctic PSC conditions. This could be mentioned if it is the case. Can it be concluded, based on these lab measurements, that only heterogeneous nucleation can be responsible for the formation of hydrate particles above the ice frost point?

Minor comments:

page 2121, line 6-8: hydrate particles will hardly grow to larger sizes than ice particles.

page 2123, line 9: remove question mark.

page 2135, line 17: I believe the measurements took place in 2002.

page 2138, line 9: in what direction will the sulphuric acid change the nucleation rates?

Table 1: units of the activation energy are missing.

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6, S613–S615, 2006

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