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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Glassy aerosols with a range of compositions nucleate ice heterogeneously at cirrus temperatures" *by* T. W. Wilson et al.

Anonymous Referee #2

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There are growing interests on effects of amorphous (semi-)solid state of organic aerosols on various atmospheric processes such as gas uptake, chemical aging, and CCN & IN activation. This study focuses on ice nucleation ability of glassy aerosols under cirrus conditions. The experiments conducted using the AIDA chamber were designed nicely, executed well, and the obtained results sound reasonable. The results have important implications on cloud formation in the upper troposphere and they are certainly interesting for atmospheric science community. I recommend publication in ACP but some points need to be clarified as below and I encourage authors to improve the presentation quality of paper.

Major Comments:

1. The authors missed to include semi-solid state at L6 in page 8996. The authors discuss only liquid vs. solid (glassy), but not effects of semi-solid. The viscosity of particle changes continuously from 10ˆ-3 Pa s (liquid like water) to 10ˆ12 Pa s (glass) when temperature approaches to Tg, but not abruptly at Tg. In this sense, the particle what you call "liquid" might be actually not liquid but already semi-solid (10ˆ2 – 10ˆ12 Pa s; viscous, gel-like, rubbery) because temperature is close to Tg. The authors should discuss the potential effects of high viscosity (or low diffusivity).

2. It is helpful to include quantitative information such as timescale of homogeneous mixing or bulk diffusion coefficient in glassy aerosols to show how slow is the rate of bulk diffusion in section 2.1.

3. Figure 8 shows that fraction frozen is very low (maximum 0.003). Why is it so low? Can you really argue that ice nucleation ability is general for glassy aerosol from this low fraction frozen? It might be possible that 0.3% particles have just some special properties (active surface sites, non-spherical, larger size etc.) and how can you exclude these possibilities and attribute to glassy state? I found that the results of levoglucosan are not included in Figure 8. Are there any reasons?

4. The authors argue that Kelvin effect is secondary importance, which implies particle size may not affect ice nucleation ability. Have you tried to conduct experiments with different particle size distribution to confirm it? I am wondering because size is the most important factor for CCN activation.

5. I recommend authors to improve figure quality. Some figures are very difficult to read and difficult to catch the points. Please use larger fonts in Figures 5, 6, 7, and 9. The fonts used in the current figure are too small to see in a print out. Please include legends in Figure 10.

6. Table 2 is not included in the manuscript even it is referred at L22 in page 9006.

Minor comments:

P8994, L4: “100s nm” should be “100 nm”

P8999, L11: What do you mean “amorphous deliquescence”? I have never heard of this word.

P9026, caption of Fig. 4: “panel bshow” should be “panel b show”

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 8979, 2012.