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Atmospheric Chemistry and Physics
Discussions

# *Interactive comment on* "Pre-activation of ice nucleating particles by the pore condensation and freezing mechanism" *by* R. Wagner et al.

**Anonymous Referee #1**

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Ice nucleating particles can be pre-activated when they are involved in ice nucleation or exposed to low temperatures and high RH. The latter case is investigated in this study assuming that pre-activation occurs by pore condensation and freezing. If pores of aerosol particles are filled with water below 100 % RH with respect to ice, this water can freeze at T < 237 K homogeneously without producing an ice cloud. If the ice within the pores is preserved upon heating, it can induce ice nucleation at T > 237 K. Wagner et al. investigate this mechanism of ice nucleation for a series of INPs, namely two types of zeolites, illite NX, diatomaceous earth, GSG soot, several desert dusts and a volcanic ash sample. Samples were activated by cooling them to 228 K while keeping the relative humidity at constant 95 % with respect to ice. Pre-activation occurred for temperatures up to 260 K for illite, the zeolite samples, GSG soot, diatomaceous

earth and one natural dust sample from the Canarian Islands. This ice nucleation behavior was in accordance with pore condensation and freezing assuming pores with diameters from 5 – 8 nm. For smaller pores the ice in the pores is supposed to melt below the ice freezing temperature. Freezing is limited to T < 260 K because larger pores remain empty with the applied pre-activation procedure. The experiments were well designed and conclusively discussed. The results are clearly presented. The paper is well suited for Atmospheric Chemistry and Physics and strongly recommended for publishing. Some minor revisions are suggested:

Page 29004, line 5: WELAS is usually written in capital letters.

Page 29011, line 18: delete "but"

Figure 5: This Figure should be explained better. It does not become clear how the positions of points in panels A and B are related to each other. Do they refer to the pre-activation cycle over night with constant RHice = 95 %? If yes, this should be stated explicitly. Why is point A missing in panel C? Why are points C, D, and D* missing in panel B?

Page 29015, lines 16 – 19: "In the case of heterogeneous freezing at point B*, the temperature threshold for the disappearance of the pre-activation ability could be a few degrees higher (point D*), because ice in larger pores with a higher melting temperature were present." Is it assumed that the cycle is stopped after the pore water has frozen? Otherwise the ice in the pores might evaporate when RH is further decreased?

Page 29023, lines 7 – 8: "Above 260 K, the ice in the pores melts and the pre-activation of the aerosol particles is lost." It should be mentioned that this statement refers to the applied pre-activation procedure and not to pre-activation in general.

Page 29023, lines 17 – 19: "Model calculations suggest that the pre-activation ability is linked to pores of a certain dimension with diameters from about 5 to 8 nm." Again, it should be specified that this refers to the investigated pre-activation conditions, namely, RHice < 100 % and T = 228 K.

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 28999, 2015.