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Interactive comment on "Collision dynamics and uptake of water on alcohol-covered ice" *by* E. S. Thomson et al.

Anonymous Referee #3

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I think the manuscript is generally well written which good structure and language. Since I am not well experienced with the measurement technique and the validity of the assumptions I cannot review section 2.1 and 2.2 in detail. However, I have written down a few questions which I would like you to answer and clarify in the manuscript.

The abstract is well structured and contain a short description of the method the most important results, and a motivation about why these results may be important for cloud evolution.

The topic is definitely of scientific importance for cirrus ice cloud formation as explained by the authors in the introduction.

Since I am not familiar to the measurement technique I am not qualified to review the

detailed description in the experiment section 2.1 and if the assumptions made in section 2.2 is reasonable in order to analyse the measurements. However to me these sections seem to be well written since I can follow and understand the basic principle of the measurements, how instrument is applied to study the uptake of water on alcohol covered ice, and the assumption of inelastic scattering and first-order thermal desorption.

The results are generally well described and the main findings could potentially be important for cloud ice crystal growth rates. For me it is a bit hard to follow the justification of the methanol monolayer and why you may not have more than one monolayer of methanol. What do you mean by p/10 and p/100 on page 27648, line 4. Could you describe it in words instead and give the actual pressure values used? I guess you mean that the experiments were performed at a total pressure of p, p/10 and p/100.

In section 3.1, page 27649, line 22-25 you write that in "contrast to the current experiments with hyper-thermal incident velocities that give rise to minor inelastic scattering, water will undergo efficient uptake under thermal conditions. How certain are you about this? Is the assumption of inelastic scattering well known to occur for this system or could it not be that other mechanism are important during hyper-thermal incident velocities e.g. that the D2O penetrate deeper into the surface they collide with. If this would be the case the hyper-thermal incident velocities would increase the mass accommodation and water uptake compared to the case under thermal conditions.

To me the discussion section is not as well structured as the other sections and I think part of this section could be removed since you already mention it in the result section and some parts might be good to move to the introduction (e.g. the part about previous work on page 27652 line 9-19).

To me the section named conclusions is more a summary of the main results. Consider renaming it to summary and conclusions.

Minor comments:

Cloud you please add some information about typical temperatures in upper troposphere and lower stratosphere and how these temperatures relate to the experimental temperatures.

Line 10-13 in the abstract: I guess you mean that the water molecules have a mean surface lifetime of <0.6 ms. Change the sentence to e.g.: Water colliding with methanol covered ice rapidly permeates the alcohol layer, but on butanol water molecules has a mean surface lifetime of $\leq$ 0.6 ms, enabling some water molecules to thermally desorb before reaching the water ice underlying the butanol.

Section 2.2, page 27644, line 15-16: I am not sure that I understand the sentence "That is α(T) represent the absolute fraction of molecules that collide with and are incorporated into the ice." Do you mean that α(T) represent the absolute fraction of the molecules that collide with the alcohol surface which are incorporated into the ice? Hence, is it true that α(T)=(ice uptake rate)/(collision rate)?

Section 2.2, page 27644: I might have missed it in the text but I cannot find the definition of KED2O, θi and Ts on line 26-27.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 27637, 2012.