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Interactive comment on "Impact of palmitic acid coating on the water uptake and loss of ammonium sulfate particles" *by* R. M. Garland et al.

Anonymous Referee #2

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This paper describes nice studies of the uptake and loss of condensed phase water from mixed ammonium sulfate - palmitic acid aerosol particles. The aerosol flow tube, infrared spectroscopy approach has been used extensively before for such studies but the novelty of this work is that this is the first experiment where a soluble species, such as ammonium sulfate, is mixed with an organic substance (palmitic acid) that is largely insoluble in water. The overall conclusions from this work are that the deliquescence and efflorescence properties of the particles are unaffected unless a very large fraction of palmitic acid is present, in which case a small amount of additional water uptake occurs perhaps via surface adsorption.

For the most part this is a well-written paper that describes experiments that have been carefully performed. In particular, the coupled TEM, FTIR and AMS characterization of the mixed particles is extremely thorough and provides convincing evidence that internally mixed particles have been formed. However, there is one important aspect to the analysis of the aerosol spectra that appears to have been overlooked and should probably be included for publication as an ACP paper. In particular, by analyzing the IR mode close to 1400 cm-1 in the ammonium sulfate system, one is able to determine very nicely whether the ammonium sulfate exists in a solution or solid state. The first paper to note the shift in this mode depending on aerosol physical state is that of Ewing (Weis and Ewing, JGR, 1996), but it has been used extensively by others in studies of the type performed in this paper: e.g. Han and Martin, JGR, 1999, Braban and Abbatt, ACP, 2004. Although observations of the condensed phase features due to water are informative about the overall water content of the particles, analysis of this ammonium mode may allow one to separate the water uptake due to the AS or the palmitic acid, or whether the deliquescence point of the AS is affected by the presence of the organic.

Minor points:

Page 2058, last paragraph - “if the palmitic acid were acting as a heterogeneous nucleus” Page 2058, last paragraph - It is not clear that uptake of water by the palmitic acid via adsorption warrants the statement that the “coating may be liquid-like”. There is no evidence that surface water leads to a solid becoming liquid-like. Page 2058, last paragraph - The statements about the CCN behavior are not quite correct. An insoluble component in an aqueous particle increases the likelihood of activation through a size effect alone, i.e. the Kelvin effect is lessened. And so the conclusion made in the first sentence on page 2059 is not necessarily valid. Page 2059 - The discussion at the end of the paragraph seems to assume the coatings were uniform and that water needs to diffuse through the organic coat to reach the ammonium sulfate. Isn’t the fact that ammonium sulfate readily deliquesces an indication that the coatings are not uniform and that some of the AS core is not coated?

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Figure 2. I suggest that the gas-phase water lines be subtracted to illustrate the aerosol features more clearly. Also, replace wavenumbers with frequency on the x-axis.

Figures 4 and 5. I suggest that more description of the state of the particles be given in the captions, rather just the temperature of the bath.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 2047, 2005.