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Interactive comment on "The uptake of SO_2 on Saharan dust: a flow tube study" *by* J. W. Adams et al.

Anonymous Referee #2

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This paper describes laboratory experiments on the uptake of sulfur dioxide by mineral dust surfaces, as performed in a coated wall flow tube. The paper is clearly written, the experiments appear to have been done carefully with an appropriate technique, and the work is of relevance to the atmospheric community. I recommend publication with only minor corrections below. I do have three suggestions, however. To some degree the paper is understated and I think it should give more emphasis to the following:

1. To my knowledge, this is the first application of a coated-wall flow tube technique to mineral dust studies of this type. Also, this is the first study of the impact of elevated relative humidity on the kinetics of SO2 uptake on dust, because Knudsen cells cannot operate at high RH. These points should be emphasized, in part because it is another

example of the (somewhat surprising) evidence that water does not affect the kinetics of oxidation reactions involving dust materials; see also Sullivan et al. (ACP, 2004). 2. The observation that the integrated amounts of SO2 taken up by the surface do not scale linearly with the partial pressure of SO2 is very interesting. There might be a tendency to interpret such behavior in terms of a two-site adsorption isotherm or surface saturation. The nice agreement between the kinetic model simulation of this behavior and the experiments should be emphasized more strongly as an illustration that kinetic factors can lead to this observation as this is the first illustration of this effect that I have seen. In this regard, I would add a couple more sentences to qualitatively explain the processes that make this relationship non-linear. 3. The paper would benefit from more discussion of what the irreversible chemistry might be on the surface. I know that this will be speculation to a large degree without other (e.g. spectroscopic) evidence but I think this would be valuable nevertheless.

Minor points:

1. In the Introduction, it should also be mentioned that sulfate might arise on a mineral dust particle surface by deposition of sulfuric acid vapour. It does not need to arise via heterogeneous reaction alone. 2. In the last paragraph of the Introduction, I am not sure what is meant by the phrase “allows better time resolution of uptake rates”. Surely a Knudsen cell offers better time resolution than a flow tube? 3. Experimental, Section 2.2. How has the dust been collected and prepared? Has it been size filtered, washed, etc.? 4. Page 2650. It would be valuable to compare the values of dust mass/geometric surface area in this work to the same ratio in the work of Underwood et al. (2000) to show that the films were of comparable (or lesser) thickness, thus giving justification to using the BET surface area to scale the uptake coefficients in a linear manner. 5. Page 2651. Was a control experiment done on a tube prepared in an identical manner to one prepared in a dust experiment, i.e. with the ethanol and parafilm plug, but without the dust? I wonder whether the ethanol may have extracted organics from the parafilm and formed a reactive surface coating of them. 6. Last paragraph in section 3.2. “Obtain”

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should be “obtained”. 7. What is the line in Figure 7?

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 2643, 2005.