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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the influence of fuel sulfur induced stable negative ion formation on the total concentration of ions emitted by an aircraft gas turbine engine: comparison of model and experiment" *by* A. Sorokin et al.

Anonymous Referee #1

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Summary: The paper discusses the introduction of a free model parameter f_{det} describing the relation of the electron detachment efficiency of sulfur bearing ions (SO_x^-) and O_2^- ions in the combustor of an aircraft engine. Because of the higher electron affinity of the sulfur bearing ions the conversion of O_2^- into SO_x^- ions changes the electron detachment efficiency and consequently the chemiion concentration in the exhaust plume. The paper performs a sensitivity study of f_{det} and discusses the influence of the chemiion formation rate Q. The modelling results are compared with measurement results performed at the exit plane of an aircraft engine combustor.

Comments: Because important modelling inputs are presently unknown (e.g. ion for-

mation rate, temperature dependent rate constants, details of the ion evolution) the paper investigates the influence of the electron detachment efficiency treated as a (currently freely adjusted) parameter on the concentration of chemiions at the exit plane. The paper discusses an interesting aspect of chemiion evolution that might have a major influence on the total chemiion concentration at the exit plane, but the presented sensitivity study of f_{det} alone and without any further constraints seems to be only a small step forward in understanding chemiion evolution in an aircraft engine, especially when considering that the qualitative statement (that the differences observed in the experiment are a result of the differences in electron detachment) is apparently already stated in Haverkamp et al. (statement in the manuscript's introduction). A more detailed study about the influence of the detachment efficiency on the total chemiion concentration should include f_{det} as a time-dependent variable. As the ion evolution proceeds in the post-combustor zone, the concentration of the more stable ions increases and f_{det} decreases. Does this have an influence on the exit plane ion concentration? What would be the expected influences of combustor temperature and temperature development in the post-combustor zone? In the low fuel sulfur content setting, in how far do other stable ions like CO_3^- or NO_3^- replace the sulfur-bearing ions?

The authors should also compare their results with the detailed model by Starik et al., Aerospace Sci. Tech., 2002. Does their model yield any new/different results? The model by Starik et al. treats all the separate ion species explicitly.

Currently, a description of the experimental results is not available because the cited paper by Haverkamp et al., 2003, has not been published yet. Therefore, a more detailed description of the experimental results would be helpful, especially error bars indicating the uncertainty of the experimental results should be added.

Technical correction: from fig. 5 and from the text it seems that the experimental arrow for HSFC should be located at 2x10^8, whereas fig. 1 indicates 3x10^8 (tickmark 2x10^8 is covered by model data).

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Interactive Comment

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 6001, 2003.

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