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Emission of ions and charged soot particles by aircraft engines

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Abstract. In this article, a model which examines the formation and evolution of chemiions in an aircraft engine is proposed. This model which includes chemiionisation, electron thermo-emission, electron attachment to soot particles and to neutral molecules, electron-ion and ion-ion recombination, ion-soot interaction, allows the determination of the ion concentration at the exit of the combustor and at the nozzle exit of the engine. It also allows the determination of the charge of the soot particles. For the engine considered, the upper limit for the ion emission index EI_i is of the order of $(2-5) \times 10^{16}$ ions/kg-fuel if ion-soot interactions are ignored and the introduction of ion-soot interactions lead about to a 50% reduction. The results also show that most of the soot particles are either positively or negatively charged, the remaining neutral particles representing approximately 20% of the total particles. A comparison of the model results with the available ground-based experimental data obtained on the ATTAS research aircraft engines during the SULFUR experiments (Schumann, 2002) shows an excellent agreement.

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