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Activation of kerosene soot to cloud condensation nuclei when exposed to OH, O_3 and SO_2 .

DENIS PETITPREZ[1], JUNTENG WU[2], ALESSANDRO FACCINETTO[1], SÉBASTIEN BATUT[1], PASCALE DESGROUX[1], MATHIEU CAZAUNAU[3], EDOUARD PANGUI[3] AND JEAN-FRANCOIS DOUSSIN[3]

[1]PC2A, UMR CNRS 8522, Université de Lille
[2]LaMP, UMR CNRS 6016, Université Clermont Auvergne
[3]LISA, UMR CNRS 7583, Université Paris-Est-Créteil, Université de Paris, Institut Pierre Simon Laplace (IPSL)

Presenting Author: denis.petitprez@univ-lille.fr

As soon as soot particles are ejected in the atmosphere, they undergo rapid chemical and physical transformation including photochemistry and heterogeneous chemistry on the surface, condensation of low-volatility species, change of size and/or morphology. In order to better describe the impact of these fundamental processes changing soot particles into cloud condensation nuclei (CCN), we carried out experiments using well characterized soot particles and controlled simulated atmospheric conditions. Briefly, using a home-made quartz diluting probe, soot particles are sampled from a jet turbulent diffusion flame supplied with liquid fuel and introduced in the atmospheric simulation chamber CESAM[1]. In these experiments, an aviation fuel (Jet A-1 kerosene) was burned in order to investigate the role of soot emitted from the aircraft jet engines in the contrail formation.

CCN formation has been studied at different steps of the aging for each of the experiment by measuring soot activation using a cloud condensation nuclei counter and a condensation particle counter in parallel. The morphology of fresh and aged soot is assessed by transmission electron microscopy. In order to simulate atmospheric aging, different sets of conditions in the chamber have been achieved by exposing soot to O_3, to OH radicals and to O_3 and SO_2 simultaneously. All results are then used with the *k*-Köhler theory [2] in order to derive a single hygroscopicity parameter *k* which quantifies the hygroscopic property of particles. For the O_3/SO_2 experiment, the ex situ analysis of the chemical composition of the soot particles has been performed by time of flight secondary ion mass spectrometry (ToF-SIMS) to investigate the correlation between the increasing *k* and the presence of several sulfur-containing ions formed on the surface of the aged particles.

This work brings original results for understanding the process that transforms aviation soot particles into CCNs and give new insights on the formation of contrails in the upper troposphere and also more generally on the interaction between aged soot and cloud droplets.

[1]Wang et al (2011), Atmos. Meas. Tech. 4, 2465-2494.

[2] Petters M. D. and Kreidenweis S. M. (2007), Atmos. Chem. Phys. 7, 1961-1971.