Contamination induced by the use of PTFE lines in aeronautic soot sampling

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Keywords: Sampling line, airplane emissions, Mass spectrometry.
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Experimental campaigns involving aircraft engines are technically challenging, especially particulate matter characterization. Emissions from engine exhaust must be cooled and diluted prior to reaching the instruments. In almost all measurements campaigns, a sampling line is needed to connect the sampling probe and the measurement instruments. PTFE lines are often used for transferring the particles collected from the engine exhaust to the measurement instruments. In addition, these lines are often heated up to 160°C to avoid formation of particles from gas phase due to the drop of temperature when transferring the sample flow from the exhaust to the line.

Conductive silicone tubing has already shown to be responsible of sample contamination in airplane engine emission studies (Timko et al., 2009). Polydimethylsiloxane (PDMS) was found in the soot samples collected through conductive silicon tubing. The PDMS uptake by soot particles was found to be up to 30%.

In the present work we have studied the potential contamination of soot samples induced by the use of PTFE lines. We have used Time of Fight Secondary Ion Mass Spectrometry (ToF-SIMS) to characterize soot samples collected through a two meter long thermostated conductive PTFE line (Winkler GmBH), both at room temperature and heated to 160°C, and through a two meter stainless steel line at room temperature. The soot was produced using a Combustion Aerosol Standard generator (CAST, Jing Gmbh). The sample flow passed through a catalytic striper coupled with a Dekati Engine Exhaust Diluter (DEED, Dekati OY) just before entering the different lines studied to avoid the presence of organic compounds on the soot. Finally, soot particles where deposited in high efficiency quartz filters for their analysis with ToF-SIMS.

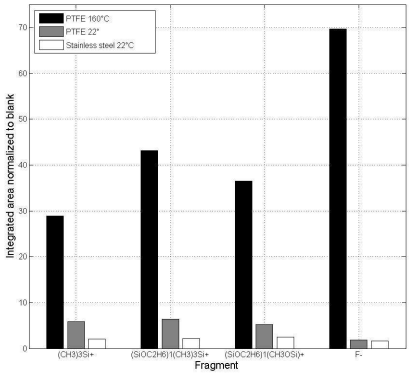

Figure 1. Integrated area for fragments corresponding to contaminants for each line studied

We found a series of peaks corresponding to PDMS associated with the use of PTFE line. This contamination was significantly higher when the line was heated. In the case of stainless steel line, the intensity of these peaks was close to the one found in the blank filter. In addition to these compounds, we found an important signal from Fluor related fragments. These fluor related peaks have been found almost exclusively when the PTFE line was heated to 160°C. After Fluor (Fig.1), the most abundant compound found in soot samples collected through heated PTFE lines was $C_4F_7O^-$ (Fig. 2), this fragment is linked to Teflon.

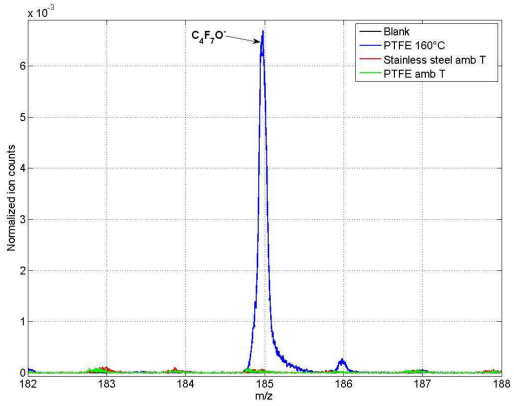

Figure 2. Mass spectra of soot samples collected through heated PTFE line.

These results show how heated PTFE lines can be a source of contamination when studying soot emissions. More detailed studies are needed to evaluate the potential impact of this contamination in soot physico-chemical properties.

This work was supported by the CORAC MERMOSE project, funded by French Civil Aviation Authority (DGAC) and by the French National Research Agency (ANR) through the PIA (Programme d'Investissement d'Avenir) under contract ANR-10-LABX-005 (LABEX CaPPA - Chemical and Physical Properties of the Atmosphere).

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