Experimental Report

Proposal: **9-10-1286** **Council:** 10/2012

Title: Night-time oxidation. Towards a model closer to reality: mixed organic films.

This proposal is a new proposal

Researh Area: Chemistry

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Samples: d-oleic acid CD3(CD2)7CD=CD(CD2)7CO2D
h-stearic acid
h-methyl oleate
h-oleic acid
d-methyl oleate CD3(CD2)7CD=CD(CD2)7CO2CH

Instrument	Req. Days	All. Days	From	To
FIGARO User-supplied	6	4	26/07/2013	30/07/2013

Abstract:

In the last decade many aerosol scientists focused their efforts on quantifying the amount of organic aerosols due to cooking processes and on determining their composition.
Our project aims to investigate the oxidation of organic coated aerosols, particularly when the main oxidant agent is NO3. We have already carried out experiments on single components, and we learnt that the surface tension drops much faster than the surface excess, thus it is not possible to relate them in a satisfactory way without neutron reflectometry.
The next step for the NEATNOx project is to move to more realistic models for cooking aerosols, with investigations into binary mixtures of the three surfactants previously studied (methyl oleate, oleic acid and stearic acid). This will allow us to understand how the interaction between the two components affects the oxidation reaction and its rate coefficient in two systems which mix on a molecular level and one reference system which does not (as shown using complementary Brewster angle microscopy measurements).
The experimental work in conjunction with the kinetic modelling interpretation will allow tentative extrapolation to atmospheric conditions.

Preliminary report for FIGARO experiment 9-10-1286

During the experiment 9-10-1286 we investigated NO_3 oxidation of mixed organic films. The repetition of the d-oleic acid film exposed to NO_3 (conditions: O_2 1.2 lpm, ozoniser 10 intervals, NO_2 15/150) showed a slightly different reaction time respect to the previous experiment, even if the tubing and the connectors were assembled in the same way (EXP. 9-10-1233, 31/05-03/06/2013). However, we assume the reaction conditions were the same within the experimental uncertainty.

In this experiment we studied the methyl oleate itself and the mixture (1:1 molecules) of oleic acid (OA) and methyl oleate exposed to NO_3, either dOA-hMO and hOA-dMO. The settings for the oxygen flow and the ozoniser were fixed for all the measurements performed: O_2 flow rate 1.2 lpm and O_3iser at 10 intervals. The only variable was the flow of NO_2, in fact even if we vary not much the NO_2 concentration the oxidation time range is pretty wide (from minutes to hours). The clean air-ACMW interface has been recorded flowing oxygen.

It has to be underlined that the external temperature during the first 3 days (Runs 1 to 25) was ranging between 32 and 27 °C, then on the last day (Runs 26 to 41) the temperature dropped to 25.9-23.9 °C; the temperature on the FIGARO sample was always kept in the range 25.4-22.6 °C. The effect of the temperature and the relative humidity on the reaction producing NO_3 is not yet clear, however the temperature decrease is about 2 % of the initial value in Kelvin.

In Figures 1-4 the data are presented without any further correction, the reduction and analysis process is the standard one: cosmos reduction without background subtraction, reflectivity fitting with a constant background value optimised using the air-ACMW data, conversion of solvent penetration to surface excess. The time t = 0 s is defined by the gas admission to the chamber.

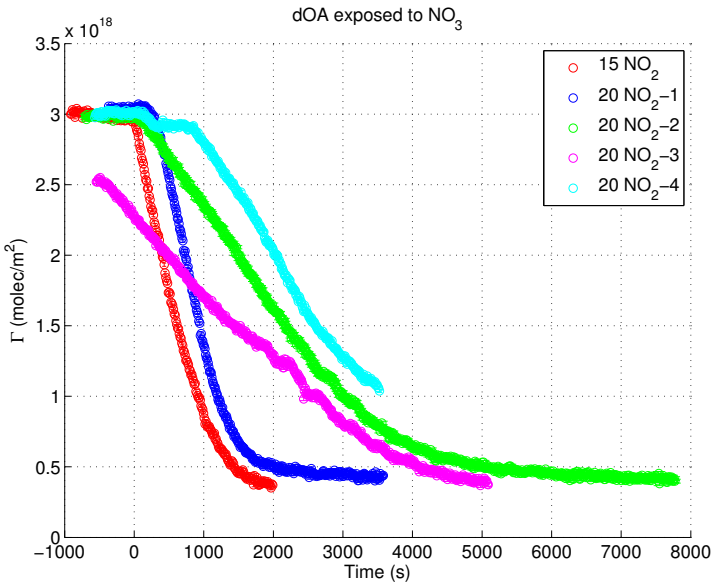

Figure 1: dOA decays: a wide variability has been recorded for the same gas conditions, the reason is still unclear.

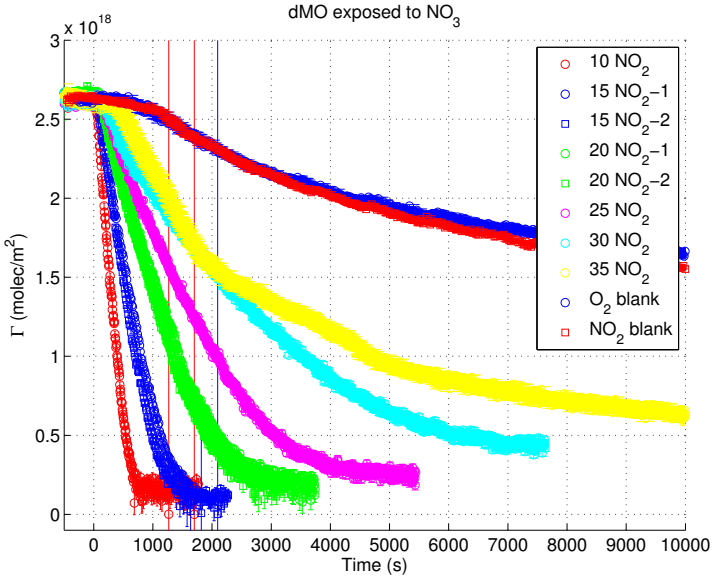

Figure 2: dMO decays: except NO_2 35 the decays look smooth and the available repeats confirm the shape.

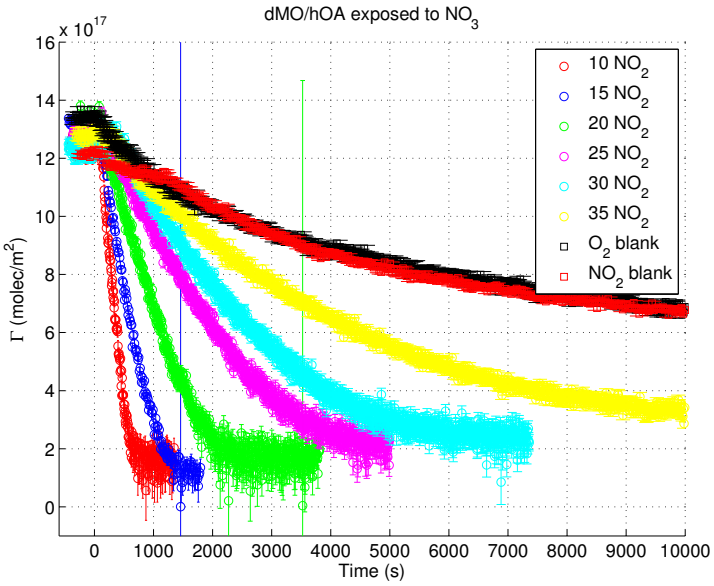

Figure 3: dMO/hOA decays: the data set is complete but no repeats are available.

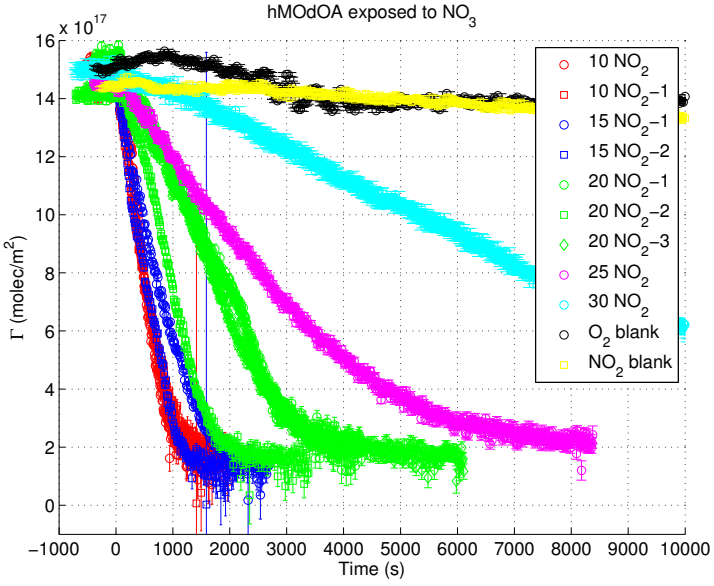

Figure 4: dOA/hMO decays: as for the pure dOA (see Fig. 1) the repeats are not always overlapping.