Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA20129

Grantee name: Dr. Cécile Sicard-Roselli

Details of the STSM

Title: Dosimetry in a liquid microjet submitted to an electron beam.

Start and end date: 01/10/2024 to 08/10/2024

Description of the work carried out during the STSM

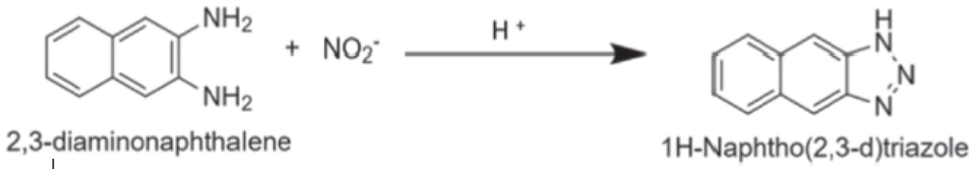
Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

In order to detect radical species produced by an electron beam in a liquid jet, we performed several quantifications:

- Detection of aqueous electrons using NO_3^- as a probe which is then reduced in NO_2^-.

$$NO_3^- + 2\,e_{hyd}^- + 2\,H^+ \rightarrow NO_2^- + H_2O$$

For that we measured nitrates formation after reaction with 2,3-diaminonaphthalene (2,3-DAN) to form 1 H-naphtho (2,3-d) triazole (2,3-NAT).



Detection of NAT by fluorescence with excitation at 360 nm and detection at 405 nm.

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarand.or ded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

- Detection of hydroxyl radicals formed using coumarin 3-carboxylic acid (3CCA) as a probe. Water solutions containing 0.5 mM of 3CCA were submitted to different irradiations and the fluorescent hydroxy-3CCA was quantified.

We thus irradiated water solutions containing 5 mM $NaNO_3$ and/or 0.5 mM 3CCA with two different energies i.e. 300 and 600 eV.

Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

(max. 500 words)

With this STSM, we could obtain several positive results:

- we could establish that the irradiation conditions (sample volume and concentration) are compatible with the detection methods allowing us to run the quantification protocols.

- Irradiation of 3CCA solutions at 0.5 mM shows the formation of 7 HO-3CCA as detected by fluorescence (Excitation at 395 nm, detection at 450 nm). This hydroxylation of 3CCA is due to the hydroxyl radicals present in the irradiated microjet. A first quantification shows an increase of HO-3CCA with the irradiation time.

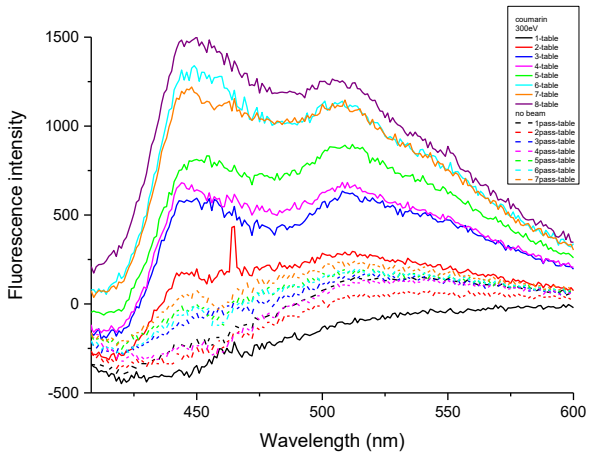


Figure 1: Fluorescence of 7OH 3CCA detected in the presence and absence of electron beam at 300 eV.

- Irradiation of $NaNO_3$ solution at 5 mM and then reaction with DAN to induce the formation of NAT. The samples were analysed by fluorescence detected at 405 nm. Small signals assigned to NAT fluorescence were detected then control experiments are necessary to confirm the electron production in the microjet..

Nevertheless, these preliminary results are very encouraging and now calibrations and control experiments are necessary to determine radical quantities generated by the electron beam, such as:

- determination of the detection limit of hydroxyl radicals and electrons in solution.

- Measurement of the pH of irradiated solution in order to detect an eventual variation that could necessitate the use of buffer.

- addition of specific scavengers in order to really assign the new signals detected to specific radicals

- modification of the beam energy to probe its impact on radical production.

Precise radical quantification is very important as it will be used in order to understand the damages induced on molecular target that will be irradiated with such electron beam.