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

Action number: **CA21126**

Grantee name: **Arun Subramani**

Details of the STSM

Title: **Probing dissociation fragments from polycyclic aromatic hydrocarbons using photo-induced fluorescence spectroscopy.**

Start and end date: **11/03/2024 to 29/03/2024**

Description of the work carried out during the STSM

The main aim of this STSM was to upgrade and test the photo-induced fluorescence spectroscopic cell (PIFS) which is to be used as an endstation for planned experiments at the circularly polarized beamline at Elettra Synchrotron, Trieste. Previous experiments with PIFS at Elettra mainly involved volatile targets that did not require additional heating and could be injected as an effusive jet through a needle. Our planned experiments target Polycyclic Aromatic Hydrocarbons (PAHs) which have low vapor pressures. Thus, a new gas inlet was designed and built to handle systems that require heating above room temperature for their evaporation into the gas phase. The heating is achieved by the fluid lines surrounding the inlet through which fluid (usually distilled water) at a set temperature flows. This ensures that the inlet is heated uniformly which will prevent any condensation of the sample on unheated patches. The gas inlet was mounted on a rotational manipulator to be used for alignment. The input gas line to the inlet was also modified to have the provision to send in another gas (for calibration) without removing the target sample.

The PIFS cell, which had previously been used at a different beamline, was completely reassembled to optimize compatibility with the CiPo beamline. Here modifications were made to the original design for where the terminal cups, vacuum gauges, windows, and ion detector were to be mounted. Once all the components were mounted, individual tests were carried out to test whether the components were still working. This was followed by vacuum tests, to ensure no leaks were present in the current configuration. After the vacuum tests, the heating system was tested, with which the upper bound to the temperature was set. The system in its current configuration is depicted in Fig. 1.

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded 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.

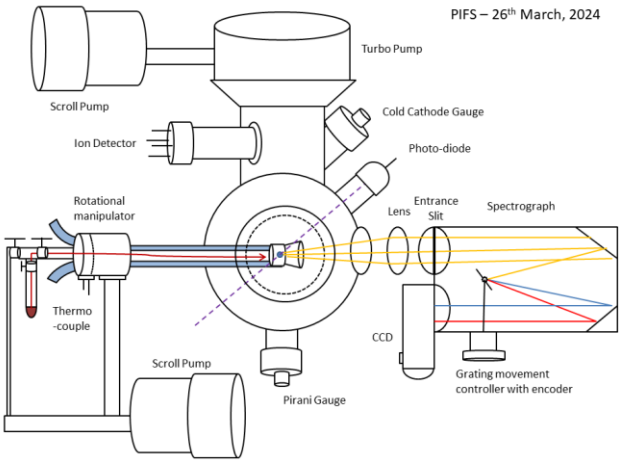


Figure 1: PIFS cell schematic

The spectrograph consists of two gratings of 1200 lines/mm blazed at two wavelengths to be used to disperse the fluorescence. The rotation of the grating to scan different wavelength regimes was calibrated using a mercury vapor standard lamp. The CCD used to record the fluorescence is to be cooled using liquid nitrogen to reduce dark noise. Thus, tests using liquid nitrogen were carried out to see the extent to which the CCD could be cooled. The Data acquisition software written in labview was originally meant for interfacing with the gasphase beamline. This system was also modified and tested to ensure it would work with the current Ci-Po beamline.

Upgrades were still being carried out in the main synchrotron ring and thus there was no light available in the beamline. Thus, the polarisation characterisation experiments for the undulators that were planned originally could not be carried out.

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

Experiments with the PIFS endstation were last performed in Elettra in 2015. Later on, part of the cell was even transported to Korea for future experiments and then lay unused for years. One of the main achievements of this STSM was to get the cell working again and to prove it was ready for further experiments. Furthermore, with the inclusion of the new gas inlet, the capabilities of the cell have also been improved to handle a wider range of targets. Multiple adjustments and fixtures were made which would have otherwise had to be done during the beamtime. Follow-up experiments like the undulator characterization were also planned to be done just before the beamtime.

During the STSM, a new joint Elettra beamtime proposal was written and submitted for review. This proposed experiment aims to probe HCN and HNC fragments from PANHs. This experiment if scheduled, would be the first to experimentally distinguish between the two neutral isomers. In the proposal process, the current collaboration between the Stockholm and Trieste groups was expanded to include an expert from the Max-IV synchrotron who had done similar experiments in the past. Thus this STSM had achieved another one of its goals of promoting the creation of new inter-disciplinary research teams.

Apart from the currently scheduled and newly proposed experiments, further follow-up experiments are also being planned at other synchrotrons. The cell in its current configuration is compact and can be moved if required. This is a major improvement and a necessity, as Elettra will be shutting down for major upgrades after the summer of 2025 and thus the portability of the cell would ensure this line of research would continue independent of the status of Elettra.