DESIGN AND CONSTRUCTION OF AN X-Y-Z MOTORIZED HEAD TO PERFORM DEEP-UV RAMAN FROM -30 TO -5 ºC (CORaHE)

The Idea is to develop an automated Cold Raman Head sensor for Deep-UV Raman spectroscopy, with X-Y-Z micrometric resolution, to operate in the range -30 to -5 ºC.

It could have applications in analysing Ice-core climate records, Snow and Permafrost, Organic compounds and Hydrated minerals, as well as, in the field of Low-temperature molecular electronics, Frozen Food, Protection from Ice or Future Robotic Missions to Icy Worlds.

Our project is coordinated by the University of the Basque Country (UPV/EHU, Leioa, Spain) and the partners are the Basque Centre for Climate Change (BC3, Leioa, Spain) and the SME company Probtech Innovations S.L. (PTI, Sopela, Spain).

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Tasks

1.- *Procurement and testing of existing materials*. (months 1-3)

2.- *Construction of the excitation and collection modules*. (months 3-8)

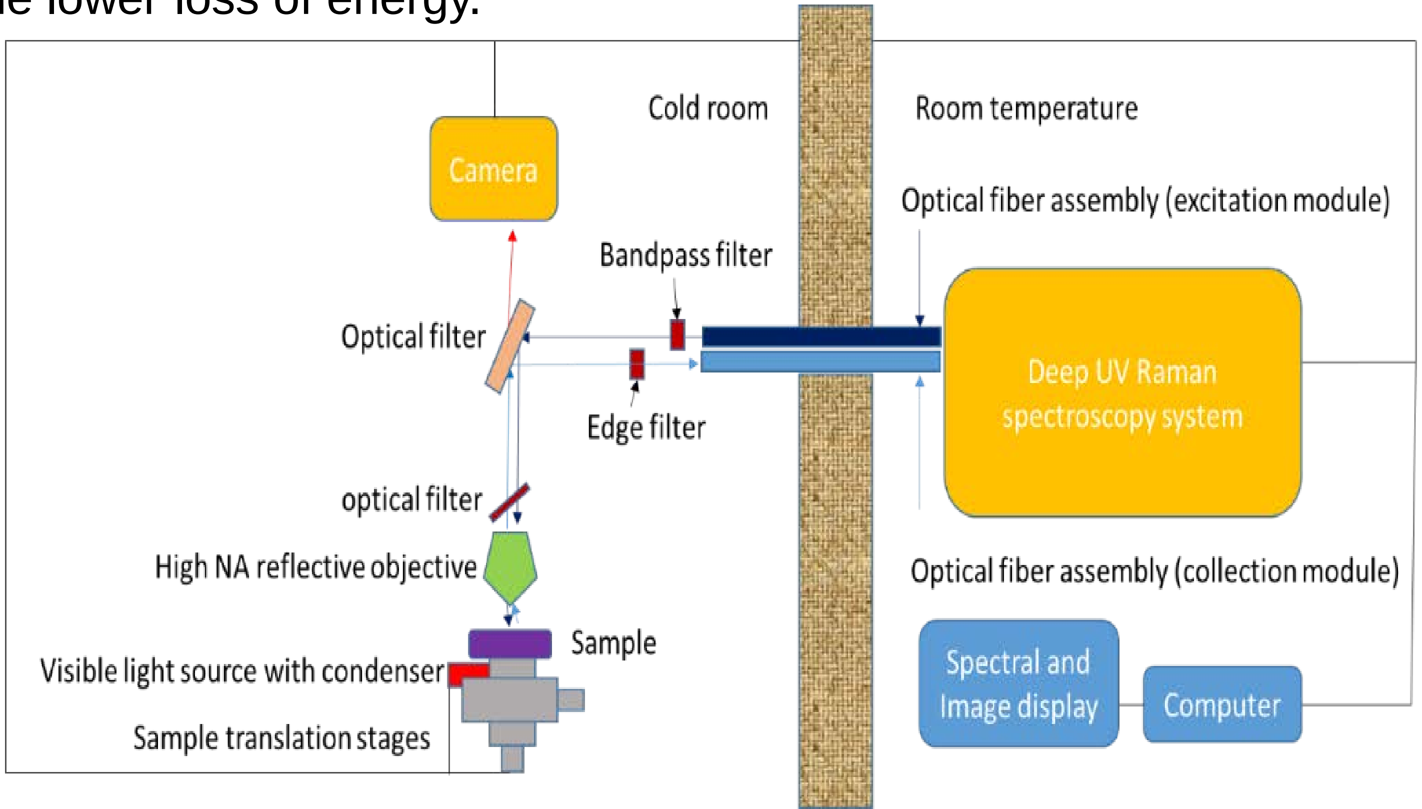
3.- *Integration of the CORaHE sensor in the BC3 cold room with the Raman spectrometer*. (months 8-11)

4.- *Validation of the sensor for Deep-UV Raman measurements*. (months 10-12)

5.- *Preparation of materials for dissemination*. (months 9-12)

1.- *Procurement and testing of existing materials*. (months 1-3)

Materials in the market that can be used in the CORaHE sensor will be selected but only those with positive response at -30 ºC will be used. Moreover, fibres, jackets, cables, filters and objectives will also be optically tested, measuring the transmission of Deep-UV light through the individual components, selecting the elements with the lower loss of energy.



2.- *Construction of the excitation and collection modules*. (months 3-8)

High OH quartz optical fibers with low-solarization and an attenuation < 350 dB/km will form the core of excitation and collection modules. These modules will enable transmission of deep UV light between the cold and normal temperature rooms. Fiber core size of 400 um and an NA of 0.22 will be selected, resulting in ultrahigh UV transmission at 248.6 nm at very low temperatures such as -30ºC.

Optical filters which can sustain this low temperature will also be used. The excitation and collection modules will combine the optical fibres, optical filters, deep UV optics for light coupling and collimation and an enveloping jacket of a suitable material. It has been taken care that those components which are not available off the shelf, can be procured to fit our design.

3.- *Integration of the CORaHE sensor in the BC3 cold room with the Raman spectrometer*. (months 8-11)

The Deep-UV Raman spectrometer must be kept at room temperature for a proper performance of optical bandpass and edge filters. Additonally, the CCD camera for Deep-UV Raman is also not designed to work optimally at -30ºC.

The reflective microscope objective, integrated in the high precision translation stage, will be coupled to the Raman excitation and collection modules and also to the context image acquisition system in cold room, forming the complete CORaHE sensor. Finally, the Deep-UV Raman spectrometer kept at room temperature will be coupled to the other end of the Raman excitation and collection modules.

4.- *Validation of the sensor for Deep-UV Raman measurements*. (months 10-12)

The performance of the new sensor coupled to the Deep-UV Raman spectrometer will be validated at two levels. Raman spectra of cold hydrated minerals of known composition will be obtained with the new system in the BC3 cold room and compared with spectra obtained with a standard Deep-UV Raman spectrometer using a cryostage.

Inclusions in ice samples will be measured using the current practice (slicing of ice, setting in the cryocell and micro-Raman measurements) and the new proposed method without destroying the ice samples.

5.- *Preparation of materials for dissemination*. (months 9-12)

In the last four months of the project, the different dissemination materials described below will be prepared. All the materials purchased and tested in Task 1 and Task 2 will be documented and photographed.

The integration of the sensor will be video recorded for dissemination as well as the validation procedures.