Spectroscopy of biological systems

Insight of lichens as ideal models for astrobiological studies analyzed by Raman spectroscopy

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Exposure experiments of different species to space conditions are essential because real space conditions with different radiation sources like ionizing radiation, UV-radiation, X-rays, gamma-ray from even galactic radiation, vacuum and space weathering by micro-dust cannot simultaneously be simulated in parallel even in our best simulation chambers on Earth. We need results from experiments under real space conditions to enable the development of appropriate predictions about the stability of organisms and their constituent organic parts. The extremophile lichen Circinaria gyrosa is one of the selected species within the BIOMEX (Biology and Mars Experiment) experiment and in this work we compare the previous Raman results obtained in this lichen [1] with the corresponding Raman results on the lichen Xanthoparmelia hueana. Both species have been exposed to space and simulated Mars-like conditions in planetary chambers and we have studied and identified possible degradation process in different layers and biomarkers.

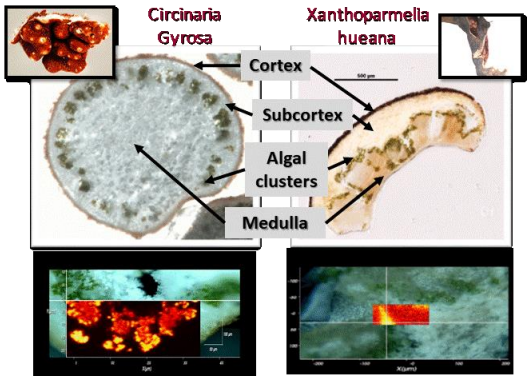

Figure 1. *Original lichen species of Circinaria gyrosa and Xanthoparmelia hueana and the thin sections of them. The lower Raman images show the algal cluster of each lichens filtered by 1524 cm^{-1} ν(C=C) carotene band.*

The analysis by Raman spectroscopy of simulated Space and Mars exposed samples confirm alterations and damages of the photobiont part of the lichen and changes related to the molecular structure of whewellite. The conclusions of this work will be important to understand what are the effects to consider when biological systems are exposed to space or Mars-like conditions and to expand our knowledge of how life survives in most extreme conditions that is a prerequisite in future planetary exploration projects.

Keywords: Raman Spectroscopy; Extremophile; biomarkers.

Acknowledgment

Support for this work was provided by the Spanish Ministry of Economy, Industry and Competitiveness (MINECO), by the project BIOindicadores en MARTE y Espacio (BIOMARSS) (PID2019-109448RB-I00) and by INTA.

References

[1] M.R. Lopez Ramirez, L.G Sancho, J. P. de Vera, M. Baqué, U. Böttcher, E. Rabbow, J. Martínez-Frías, R. de la Torre Noetzel. Spectrochimica Acta, Part A. 261 (2021) 120046.