LIBS molecular signals in Martian atmosphere as a tool in the search for biosignatures.

Tomás Delgado, Adrián Alba-Gutiérrez, Javier Laserna

Departamento de Química Analítica, Universidad de Málaga, Facultad de Ciencias, Campus de Teatinos s/n, 29071 Málaga, España

In the present study, LIBS spectra acquisition of a set of selected organic molecules related to biosignatures or their degradation compounds have been carried out in Martian atmosphere by simulating planetary exploration conditions. The study was completed with the spectral analysis in air atmosphere. There is a wide variety of compounds in the Earth that have been associated with biosignatures. This strategy can help to reveal the different response of spectral modes to atmospheric conditions and to detect which species in which molecules are most sensitive to changes in pressure and composition of the atmosphere. Since Mars atmosphere is primarily composed of carbon dioxide, plasma is known to incorporate carbon emissions from the CO_2 dissociation. It is also known that at high irradiances the atomization of organic matter is practically complete, although at sufficiently delayed integration times, the formation of new molecules by recombination can be observed. Of special diagnostic value is the observation of the C_2 dimer, which has been associated with aromatic compounds and organic matter with conjugated double bonds[1]. In addition to this, other molecular species characteristic of organic emissions such as CN, NH, OH and CH were studied due to their undeniable interest. Results can contribute to establish the optimal experimental conditions for observation of organic carbon species in laser-induced plasmas and the bases for the ensuing detection of carbon biosignatures in analogous geological materials from Mars.

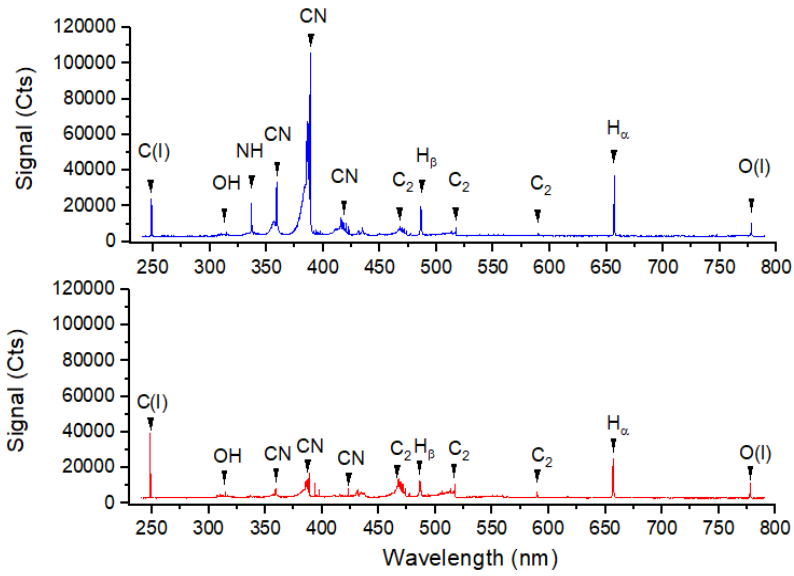

Fig.1 Ribose LIBS spectra acquired in (top panel) air atmosphere and (bottom panel) Martian atmosphere.

References

[1] T. Dequaire, P. Y. Meslin, P. Beck, M. Jaber, A. Cousin, W. Rapin, J. Lasue, O. Gasnault, S. Maurice, A. Buch, C. Szopa, P. Coll and the MSL Science Team, Analysis of carbon and nitrogen signatures with laser-induced breakdown spectroscopy; the quest for organics under Mars-like conditions, Spectrochim. Acta Part B, 131 (2017) 8-17.