Twenty years of Raman spectroscopy in exobiology research

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Abstract

Raman spectroscopy is an excellent tool for direct detecting and discriminating minerals, organics and biomolecules. Forthcoming exobiology-focused projects by NASA and ESA (Mars 2020 and Exomars 2020) will develop the use of robotic rovers to better investigate Martian rocky outcrops or subsurface rocks through a combination of imaging and spectroscopic techniques. The Mars 2020 (NASA) rover will investigate a region of Mars where the ancient environment may have been favourable for microbial life, probing the Martian rocks for evidence of past life. Exomars is an ESA and Russian space agency, (Roscosmos) project dedicated to the Mars surface, including a search of biosignatures for exobiology. The Exomars 2020 rover will carry a drill and a suite of instruments dedicated to exobiology and geochemistry research. A miniature Raman spectrometer will be part of the payload of the rover [1] . Terrestrial testing of approaches, techniques, and technologies in the frame of terrestrial "Martian" analogues was recommended as an activity of high importance for the success of the next missions [2]. Raman spectroscopy was repeatedly suggested as an excellent tool for detecting minerals, carbonaceous matter as well as biomolecules. Two decades of Raman spectroscopy in exobiology will be reviewed in this presentation. Major achievements obtained in the frame of geobiology and microbiology of extremophiles areas are presented as well. Historical and practical aspects of analysing minerals and biomarkers of high relevance for Mars will be presented. More focus is given here to practical aspects and terrestrial testing before leaving to Mars.

In applied geoscience and microbiology, laboratory dispersive Raman spectroscopic instrumentation helped first to build databases of Raman spectral signatures of minerals, organics and biomarkers, e.g. [3,4] . These data are now commonly used for studies focused to better learn about natural environments including investigations in Martian analogues on Earth. Technical progress in the last ten years, miniaturization of Raman spectrometers and new concepts allow now to collect spectroscopic data outdoors and frequently directly on outcropping layers of rocks, crusts or endolithic colonisations, e.g. [5] .

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