Raman spectroscopy of biologically relevant amino acids under martian condtions

Conference or Workshop Item

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Future studies of the martian surface may include the use of a Raman spectrometer [1]. Raman spectroscopy utilises the shift in wavelength due to the vibrational bonds in a molecule from an arbitrary wavelength of a laser incident on a sample. This provides a 'signature' spectrum for each molecule, with the individual peaks being attributed to individual bonds in the molecule. This instrument is highly useful in analysing not only geological samples but also biomarkers [2]. Mars is a prime target in the search for life elsewhere in the Solar System and the discovery of biomarkers would infer that life is potentially extant, or otherwise extinct, on Mars. Amino acids are vital molecules for terrestrial life, they are the 'building blocks' of proteins, which in turn are large contributors to the polymer structure of cells and are also catalysts in many biochemical processes. Due to this, amino acids are among the high priority biomarkers for extra-terrestrial life [3] and are the focus of this study. Here we present the results of experiments investigating the effect of martian conditions on a select group of the biologically relevant amino acids, for example L-alanine, for analysis by Raman spectroscopy. Exposure of the amino acids to martian conditions is conducted by placing a thin film of each amino acid into a Mars Simulation Chamber (MSC) over an extended time period. Raman spectra are taken of each sample before and after exposure in the MSC. Individual conditions, such as isolated temperature and pressure studies have been conducted as well as investigations into exposure to combined varying conditions. Preliminary experiments show that there are variations in the Raman spectra such as reduction in peak intensity and the introduction of new peaks at wavenumbers not seen pre-exposure. Any changes in the Raman signature post-exposure could be due to the breakdown of the molecules, or perhaps even the signal of product molecules. We aim to investigate the properties of and the spectral variation in the Raman signal of amino acids as a function of environmental conditions relevant to Mars as a precursor to results that may be returned from future Mars missions.

[1] BAZALGETTE COURRÈGES-LACOSTE, G., AHLERS, B. & PÉREZ, F. R. (2007) Combined Raman spectrometer/laser-induced breakdown spectrometer for the next ESA mission to Mars. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy,* 68**,** 1023-1028.

[2] JEHLICKA, J., EDWARDS, H. G. M. & VÍTEK, P. (2009) Assessment of Raman spectroscopy as a tool for the non-destructive identification of organic minerals and biomolecules for Mars studies. *Planetary and Space Science,* 57**,** 606-613.

[3] PARNELL, J., CULLEN, D., SIMS, M. R., BOWDEN, S., COCKELL, C. S., COURT, R., EHRENFREUND, P., GAUBERT, F., GRANT, W., PARRO, V., ROHMER, M., SEPHTON, M., STAN-LOTTER, H., STEELE, A., TOPORSKI, J. & VAGO, J. (2007) Searching for Life on Mars: Selection of Molecular Targets for ESA's Aurora ExoMars Mission. *Astrobiology,* 7**,** 578-604.

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