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Detecting biomarkers on Mars using Raman spectroscopy

S. M. Rolfe, M. R. Patel, I. Gilmour, K. Olsson-Francis, T. J. Ringrose.

The Open University, Milton Keynes, England. Contact: samantha.rolfe@open.ac.uk

Raman spectroscopy is a powerful technique for the characterisation of organic molecules as it provides a unique 'fingerprint' spectrum. Incident monochromatic light on a sample is shifted in wavelength giving rise to the Raman spectrum, with peaks that are attributable to the specific vibrational bonds within the molecule. Raman spectroscopy is useful for analysing not only geological samples but also biological molecules, and has been recommended for use as a detection method (among others) for biomarkers on missions to planetary bodies [1]. The ExoMars Rover mission is due to launch in 2018 with a Raman spectrometer as part of its scientific payload [2].

Amino acids, the 'building-blocks' of proteins, have been identified as a high priority biomarker in the search for evidence of life on planetary bodies [3]. Raman spectroscopy is often a qualitative method, but if signatures of biomarkers are detected by Raman spectroscopy, it is critical that correct identification of such biomarkers can be undertaken. To aid in molecule identification, we take a statistical approach to determine the position of characteristic peaks of several amino acids. We present evidence for statistically significant changes in the peak positions when using different excitation wavelengths. Furthermore, we present evidence that martian conditions have an effect on the Raman spectra of amino acids, which could have implications when performing *in situ* measurements on Mars.

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2. Edwards, H.G.M., I. Hutchinson, and R. Ingley, *The ExoMars Raman spectrometer and the identification of biogeological spectroscopic signatures using a flight-like prototype*. Analytical and Bioanalytical Chemistry, 2012. **404**(6-7): p. 1723-1731.
3. Parnell, J., et al., *Searching for Life on Mars: Selection of Molecular Targets for ESA's Aurora ExoMars Mission*. Astrobiology, 2007. **7**(4): p. 578-604.