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Evaluation of Raman Spectroscopy for Application in Analytical
Astrobiology

The Application of Raman Spectroscopy for Characterisation of Biological and
Geological Materials of Relevance to Space Exploration

Kristian Page

Submitted for the Degree
of Doctor of Philosophy

Division of Chemical and Forensic Sciences

University of Bradford

2011

Acknowledgements

I would like to thank my supervisors; Prof. Howell Edwards for his Raman experience, Dr Ian Scowen for his analytical expertise and Dr. Tasnim Munshi for her help and guidance throughout the course of my research. I would also like to thank Dennis Farwell for his instrumental expertise and Dr. Mike Hargreaves for their assistance at the beginning of my PhD. Thank you also to Richard and Ian for their engineering, construction and experience with the prototype Raman spectrometer and Jacquie for preparation of several inorganic and organic mixtures. I would also like to thank three Barry Hershey for his collaboration with the biomarkers work, Lewis Dartnell for his collaboration with the cellular systems work and Petr Vitek for his collaboration on the bio-geological inclusions samples.

Publications

Raman spectra of biomarkers of relevance to analytical astrobiological exploration: Hopanoids, sterols and steranes

H.G.M. Edwards, B. Herschy, K. Page, T. Munshi, I.J. Scowen

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy

Volume 78, Issue 1, January 2011, Pages 191-195

Evaluation of portable Raman spectrometer with 1064 nm excitation for geological and forensic applications

Petr Víték, Esam M.A. Ali, Howell G.M. Edwards, Jan Jehlička, Rick Cox, Kristian Page

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy

In Press, Accepted Manuscript

Destruction of Raman biosignatures by ionising radiation and the implications for life detection on Mars

Dartnell LR, Page K, Jorge-Villar SE, Wright G, Munshi T, Scowen IJ, Ward JM, Edwards HGM.

Analytical and Bioanalytical Chemistry

In Press, Accepted Manuscript

Abstract

In 2018 ESA and NASA plan to send the ExoMars rover to the Martian surface. This rover is planned to have a suite of analytical equipment that includes a Raman spectrometer. In this context, an evaluation of Raman spectroscopy as an analytical tool for interplanetary studies is investigated. The preparation techniques for appropriate inorganic and organic mixtures are interrogated. Methods are investigated to optimize the homogeneity of over 50 samples involving mineral phases; calcite, gypsum and goethite and selected organic biomolecular systems; anthracene, naphthalene and beta-carotene. From mixtures produced of these organic and inorganic materials differences between homogeneity of the samples is observed. Different mixing techniques are investigated to reduce this, however all the samples display variation on a micron scale. To resolve this issue a grid system of 9 points is implemented on solid samples and solutions are used to produce standards. The standards are devised using a range of instrument validation parameters for comparison between commercially available spectrometers and the prototype instrument. From these standards a prototype instrument is optimized for data acquisition and an evaluation procedure for instrument performance is established. The prototype Raman spectrometer is evaluated to match the specifications of the spectrometer on board ExoMars rover. A range of astrobiological relevant samples are interrogated; geological samples, biomarkers, cellular systems and bio-geological inclusions. From these samples detection of organics is observed to be only possible, with Raman spectroscopy where organics are localised in high concentrations, upon grinding and mixing geological inclusions Raman spectroscopy is unable to detect the organic components.

Key words; Raman Spectroscopy, Astrobiology, Space Exploration, Biomaterials, Geomaterials and Instrumentation

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