University Analytical Centre

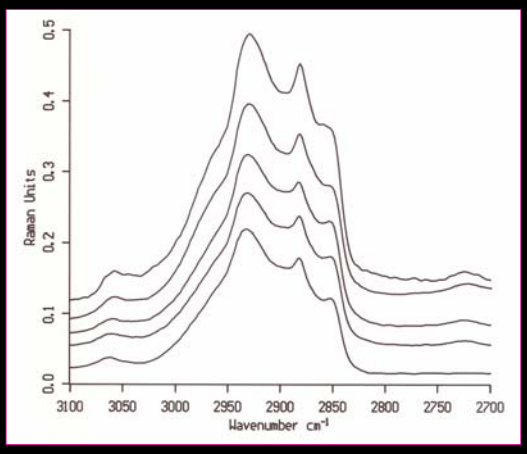
Raman Spectroscopy

- Science Team

The Vibrational Spectroscopy facility in the University Analytical Centre is led by Professor Howell Edwards. In a research career spanning 34 years, he has published over 720 papers on Raman spectroscopy and its applications and has made over 650 presentations of his research work at international seminars and conferences. The group is engaged in instrument development programs, particularly in vibrational spectroscopy, for miniaturisation of apparatus for on-site applications. These are diverse and include developments for

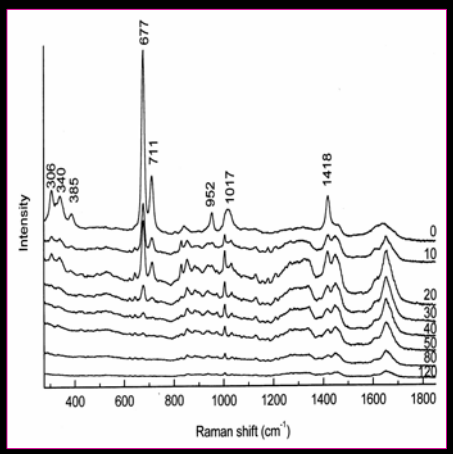
- space and inter-planetary investigations
- forensic and crime-scene applications
- medical and pharmaceutical applications

Through active inter-disciplinary collaborations, the group also develops applications for pharmaceutical, geological, archaeological and forensic fields. These include studies of materials and their degradation under extreme environmental conditions. Collaborative work in these areas is being pursued with the support of NASA, and the European Space Agency, several national and international museums and a number of pharmaceutical companies. The group has pioneered applications of Raman spectroscopy for *in situ* molecular speciation, particularly in trans-dermal drug delivery applications. Molecular mapping is a key development for these applications.



In vitro Raman measurement of DMSO treatment of stratum corneum (SC).

CH stretching modes of human SC treated for 1 hour with, from bottom to top, 0, 20, 40, 60 and 100% DMSO. Minor changes in lipid packing are evident; 2880 and 2850 cm^{-1} relative intensities change. Generally bands broaden (disorder) as DMSO concentration increases.



Depth profile of DMSO in human skin at the palm

Spectra clearly show DMSO spectral signatures in the tissue. Experiment showed rapid permeation after application. The signal intensity are internally calibrated through normalisation of DMSO 677 cm^{-1} band vs 1450 cm^{-1} band

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- ## Facilities

  The Centre enjoys access to an extensive range of instrumentation allowing optimisation of experiment and, though a range of excitation frequencies, opportunities to overcome fluorescence often associated with biomoleculer systems. A range of portable instrumentation allows evaluation of at-site measurement, recently applied in crime-scene and security applications.

  - Bruker IFS66/FRA106 + Ramanscope
    - FT-Raman + FT-IR
    - 1064 nm
  - Renishaw InVia Confocal microscope
    - 785 nm, 633 nm, 515 nm, 488 nm
    - Line-focus mapping stage
  - Digilab FT-IR Microscope
  - Renishaw Raman RX210 (RIAS)
    - Portable, remote probe 785 nm
  - Delta-Nu Inspector Raman FSX
    - Point-and-shoot portable 785 nm

African Elephant

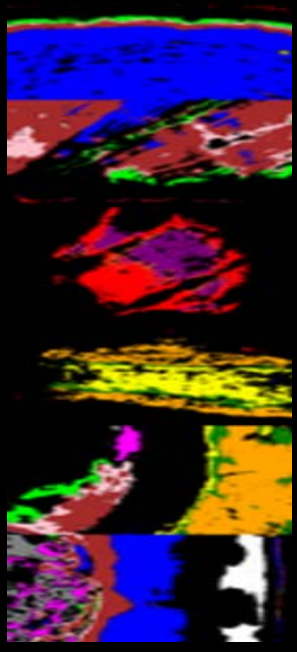
Boar tusk

Hippopotamus tusk

Mammoth tusk

Sperm Whale

Walrus



NIR Imaging Discrimination of Ivory Type via Multivariate Image Analysis – a potential replacement for traditional visual inspection processes giving significant improvements in time of identification and non-expert user application