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Micro-beam laser ablation/mass spectrometry for materials depth-profiling and elemental surface distribution studies- polymers, waxes, asphaltenes, steels

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Our group has developed a sensitive, semi-quantitative technique for evaluating the distribution of bulk metals in certain matrices (such as polymers, steels), and precisely locating points on the surface of materials for studying spatial distribution. This paper is an overview of the capabilities of laser ablation, which has evolved into an excellent tool for scanning the surface of rigid materials to determine surface homogeneity. It is equally useful for 'drilling' beneath the surface of a solid matrix to assess the composition of the substrate. The technique has been known to be suitable for semi-quantitative analysis of dense, compact samples, but recently we revealed that soft samples can also be studied by pre-treating them with liquid nitrogen. Samples subjected to this treatment (such as asphaltenes, waxes) tend to thaw, so analysis must be quick and accurate, within the 'thaw' time. The laser itself is attached to a high performance ICP-MS system. A 213 nm micro-beam is deployed to perform iterative surface scans at randomly selected points to determine compositional consistency. The technique is also capable of ablating depths up to 50 μm at selected intervals (usually 10 μm), and measuring characteristic intensities of elements of interest. These studies are mainly qualitative, in the absence of standardization. Suitable software is used to program the micro-beam to delve to specific depths in sample matrices, and the technique is subjected to rigorous calibration and background correction. Minor perturbations in instrumental performance are adjusted by internal standards. Overall, the technique is of considerable use in materials analysis.

Biography

Avin Pillay is skilled in a wide range of instrumental techniques including Neutron Activation, XRF, PIXE, Gamma-ray Spectroscopy, ICP-MS, Atomic Absorption and UV-Vis Spectrophotometry. He is experienced in the area of Analytical and Environmental Chemistry, and has supervised post-graduate students. He has lectured widely in these areas and in general chemistry, and is keen on promoting cross-disciplinary teaching and research. He has published more than 130 peer-reviewed journal articles, and several conference presentations. He was Guest Editor and Editorial Board Member of the *International Journal of Environmental Studies* between 2005 and 2009. He is presently an Editorial Board Member of the *Open Hydrology Journal* and *Journal of Research and Environment*. He has contributed to the proposal of the MSc program in the Chemistry Department at the Petroleum Institute.

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