

## **RAMAN SPECTROSCOPY AS A TOOL FOR HISTORICAL OBJECT ANALYSIS**

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The modern conservator has at his disposal a variety of analytical techniques. Advances in sensitivity and portability have further expanded the portfolio, and with it, the understanding of a remarkable diversity of buildings and objects of historical importance.

Chief among these techniques is Raman spectroscopy. Since the earliest benchtop Raman microscopes, non-destructive analysis of paint palettes, building materials, corrosion and degradation products have formed an integral part in the development of this branch of analytical science. Its ease of use and applicability to a wealth of sample types has seen the method's popularity continue to grow in this arena.

A characteristic spectrum with bands corresponding to vibrations of molecules is acquired on the interaction of a laser with the sample. As such, it is a compliment to the more widely-adopted infrared (IR) spectroscopy. Raman spectroscopy can permit, for example, the unambiguous identification of micrometer-size particles of pigments in paint or sources of environmental pollution. In turn, this information can be used by restorers and those investigating authenticity. Although regarded as a non-destructive technique, sampling requirements generally require a small section of paint (approximately 1 mm<sup>2</sup>) to be removed and care taken to avoid damaging some naturally-occurring pigments through absorption of the laser. Fluorescence can occur, preventing successful analysis but can often be circumvented through the selection of the appropriate exciting laser wavelength.

Recently, Raman spectroscopy instruments have been integrated with other analytical techniques, creating synergy. Adding Raman spectroscopy to established Scanning Electron Microscopy (SEM), Energy Dispersive X ray analyses (EDX), creates a powerful tool. Examples are given illustrating how this combination of high resolution imaging and chemical and molecular structural analysis has been applied to historically-important building materials and statues.