

The Present and Future Potential of Raman Spectroscopy in the Characterization of Gems and Minerals

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A number of important breakthroughs have occurred in recent years which are allowing Raman spectroscopy to take its place alongside other mainstream analytical methodologies as a routine and powerful analytical tool. The long-standing limitation in sensitivity and the detection limit capabilities of conventional Raman have now dropped to the levels of parts per million and in some cases even below. This has resulted from a combination of technological advances in optical components, sources, and detector technology. New optical components include volume phase holographic elements, a variety of unconventional aspheric optical systems, and ever-improving CCD and CID array detectors. Diode lasers have provided improved reliability, systems miniaturization, and more optimized wavelength selection.

Advanced technologies developed for fiber-optic telecommunication are now being applied to implementing an entirely new generation of miniature spectrometers. Optical systems for entire spectrometers can be built in volumes of fractions of a cubic centimeter. New approaches for optical component fabrication, mounting, and alignment have been developed which yield highly robust systems capable of providing exceedingly high levels of performance. Performance considerations and design “trade-offs” will be discussed. A new generation of hand-held Raman spectroscopic instrumentation is currently being introduced which is intended to provide analysis of real world samples and will find application in the fields of process control, product quality control, medical diagnostics, environmental analysis, and even the analysis of gems and minerals.

This presentation will discuss how ongoing advances in instrumentation will help move Raman into the mainstream of routine gem and mineral identification.

The use of Raman spectroscopy for the unequivocal nondestructive determination of the authenticity of gems, however, requires a credible database as well as appropriate search algorithms. Such a database is currently being developed by the RRUFF project as a public domain asset sponsored by Mike Scott. The following paper will describe the RRUFF Raman mineral program in detail.