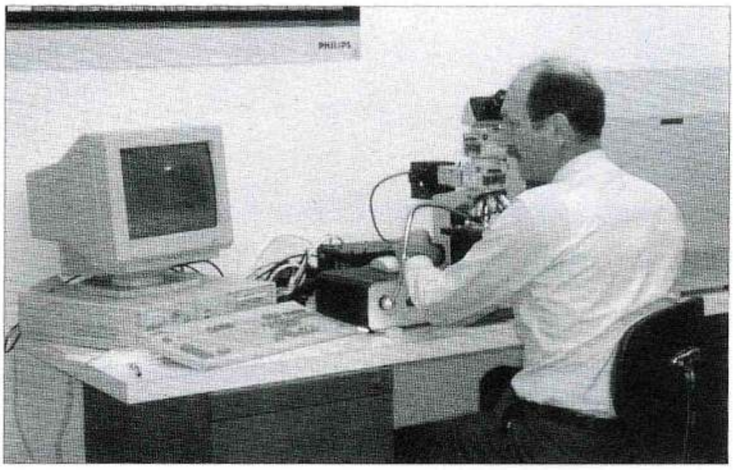
# Raman microprobe fingerprints fillings

By Dr. H.A. Hanni SSEF Swiss Gemmological Institute, Basel

**Our new gemological service of recording Raman spectra of fracture fillings is still unknown to most gemstone dealers.**

Due to recent technical developments in microelectronics, the Raman effect, a general physical principle that was only previously applied in advanced chemical and physical research, can now be practically used as a versatile analytical tool in the gemological laboratory.

The Indian physicist C.V. Raman was the first to observe that scattering of light occurred when molecules are hit by a monochromatic light beam. The change of frequency of the exciting radiation can be measured and most substances produce characteristic spectral lines which can be used for identification.



Dr. Henry A. Hanni operating the SSEF Raman microprobe

A Raman microprobe, which produces and measures the Raman effect, is a combination of a microscope and a computer which operates the Raman Microscope System. The light source is furnished by an argon gas laser. Any substance on which the beam is focused can be analyzed.

Interestingly, the material can be a gas, a liquid or a solid substance. However, the technique is limited to molecular compounds: materials like metallic alloys are not suitably analyzed by this technique.

The Raman effect has been used to study and analyze materials for almost 25 years and producing and recording the Raman effect is now a basic research technique. However, Raman microprobes have traditionally been large and very expensive instruments. Raman microprobes so far are used in some chemical and physical research labs. In the field of mineralogy, French research laboratories in Nancy, Lille and Nantes have performed Raman analyses for many years.

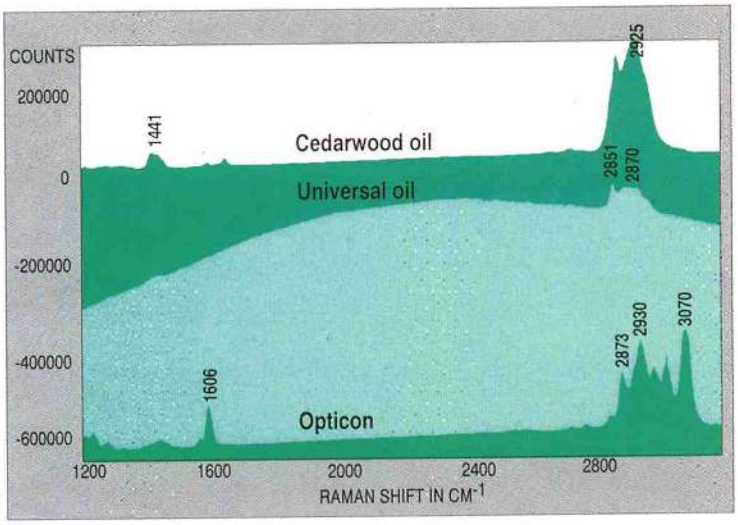
Although the principle has

long been known and applied in advanced labs, miniaturization and advances in equipment design have resulted in the availability of a Raman instrument that can be purchased and operated by an advanced gemological institute. A few gemological research labs have already obtained experience, among then CRG Nantes, AIGS Bangkok, CISGEM Milan and SSEF in Basel.

The SSEF Swiss Gemmological Institute has been using a Renishaw Raman microprobe for some months.

As a result of our assessment, SSEF concluded that the Raman microprobe is one of the strongest tools available for nondestructive testing of gemstones. The greatest advantage is that the laser beam can reach inclusions which do not even reach the surface of a gemstone. The sample to be examined does not need any preparation except cleaning.

The potential of this analytical technique is far-reaching. For example, it is possible to identify CO2 in a fingerprint inclusion of a sapphire. Mineral inclusions such as mica in emerald, zircon in ruby, garnet in diamond are easy tasks. It is also possible to identify, by comparison with reference spectra, different organic substances such as oils. resins, epoxy including Opticon, Palm Oil, and other substances. The full potential of the Raman microprobe is hard to overestimate.




In the SSEF laboratory, special attention was given to the possible identification of fracture filling substances. We traced foreign material in fractures of diamonds, among them in Koss and Yehuda treated stones. Also, a whitish substance repeatedly has been found which seems to be a reaction product between natural soil remnants and cleaning and cooling chemicals applied under heat. For identification of foreign artificial fillings in fractures of emeralds we first built up a library of comparison spectra (oil, cedar wood oil, epoxy resin etc.). It is now frequently possible to attribute a spectrum recorded from a treated emerald to one of the filler materials in our data bank.

Our new gemological service of recording Raman spectra of fracture fillings is still unknown to most gemstone dealers. No doubt this significant progress in our ability to identify fracture fillings will be welcomed by many in the trade, as it has been by the gemstone dealers in Geneva who financially supported SSEF's purchase of the instrument. Perhaps others in the trade will not be so happy with this revolutionary new opportunity to unveil the identity of fracture fillings!

Contact SSEF for more information about our new service: SSEF Swiss Gemmological Institute, Falknerstrasse 9, CH 4001 Basel, Switzerland, telephone (41) (61) 262 0640, fax (41) (61) 262 0641.