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Fast on-site identification of minerals by using portable Raman equipment in gemological trade contexts and in collectors exhibitions

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In the gemological trade the availability of well-manufactured imitations and synthetic gems and the use of treatments has become a common trend, causing new problems in gems certification. Minerals having a gemological interest can be investigated by performing standard tests, but the identification and certification of gemological materials is not always easy and immediate, especially in the case of gems mounted in jewels. In addition, at exhibitions, collectors often request a fast identification of minerals in very difficult environmental conditions. In these cases, fast, non-invasive and non-destructive methods that give reliable information on composition of minerals are extremely valuable for gemologist and collectors. Raman spectroscopy represents the most powerful of these methods, especially considering the availability of high-resolution portable systems (Barone et al., 2014; Jehlička et al., 2011; Vítek et al., 2012; Víteket al., 2013). However, some problems related to in-situ measurements such as noise due to environmental conditions have to be considered.

The main aim of this work is to highlight the potential of portable Raman spectrometry in the fast characterization of minerals at events as exhibitions, during which collectors and gemologists may purchase gems, often without compliance certifications. Measurements have been carried out on two set of samples, namely loose/mounted gems and minerals supplied by gemologists and collectors, respectively. In detail, data have been collected by means a handheld Rock Hound (Delta Nu) Raman spectrometer equipped by a 785 nm diode laser and a portable Enwave Optronics EZRAMAN-I-DUAL (Lauwers et al., 2014) equipped with a diode laser (785 nm) and a Nd:YAG laser (532 nm). A large number of samples, representing some of the most diffused and valuable examples of gems and minerals available in the gemological market and the collecting field have been analyzed and characterized in really easy way and short time

(Figure 1). The instruments can be connected via a USB cable to a laptop and Raman spectra have been simultaneously visualized, allowing a live identification of materials. Among gems supplied by gemologists, several varieties of quartz, as well as garnets, beryl, corundum and feldspars have been identified. The most useful results have been obtained for mounted gems, for which traditional gemological tests cannot be performed without removing the stones from their sets. During the Monza 2013 Mineral Exhibition about 64 tests were performed on anatase, apatite, demantoid garnets, topaz, benitoite, vesuvianite and other minerals, allowing the absolute identification of the 80% of the studied materials.

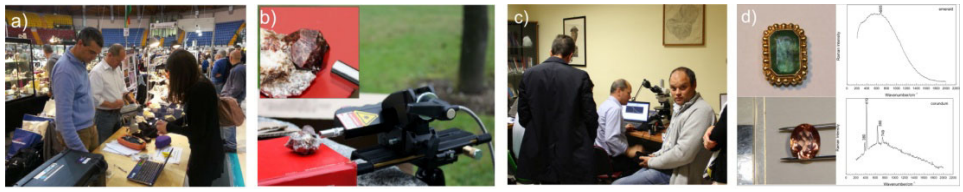

Figure 1. (a) Raman in-situ measurements at the Monza 2013 Mineral exhibition; (b) measurement on almandine with Enwave instrument; (c) Raman in-situ measurements with gemologist; (d) Examples of measurements performed on mounted and loose gems with Delta Nu instrument.

We have demonstrated the potential of portable Raman equipment in the fast in situ certification of minerals, even in very difficult environmental conditions. Additional strategies such as focusing optimization, the use of enclosures to reduce stray light, adjustable laser power and multiple laser energies can further improve the performance of portable Raman systems. In conclusions, by using this method, it is possible to supply fundamental information for gemologist and collectors, especially in the framework of sales agreements.

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