Applications of Raman and photoluminescence spectroscopy in gemmology

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The goal of this keynote lecture is to convince the audience that the prime "enemy" of Raman spectroscopists, namely, unintentionally excited laser-induced PL (photoluminescence), may serve as a quite valuable tool in characterising gemstones. After a brief introduction to the physical basics of the two techniques, a variety of examples for their application in gemmology is presented. Examples will include the non-destructive gem identification by Raman and PL spectral fingerprinting, but also go beyond that: the use of Raman and PL in characterising gemstones, such as their compositional peculiarities, unravelling potential treatments and synthetics, etc.

References
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Watenphul A, Burgdorf M, Schlüter J, Horn I, Malcherek T, Mihailova (2016) Am Miner 101:970–985
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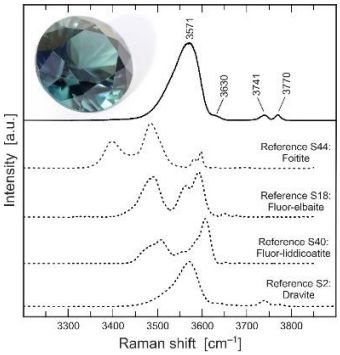

Figure 1: This 0.90 ct blue dravite from Elahera, Sri Lanka (Nasdala et al. 2021), yielded a pattern of O–H stretching Raman bands that deviates appreciably from those of Li-bearing tourmalines (reference spectra from Watenphul et al. 2016).

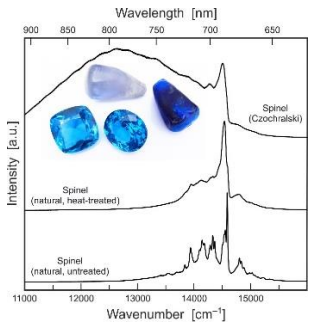

Figure 2: PL spectroscopy is used to unravel heat-treatment of natural spinel, and to discriminate natural from melt-grown synthetics. Heating of "normal" spinel leads to partially "inverse" cation occupation, seen from broadened Raman (not shown) and PL signals (Mohler and White 1995; Widmer et al. 2015). Non-stoichiometric synthetics typically yield similar or even more broadened spectra. All spectra obtained with 473 nm excitatio