

LONG LIVED NEAR INFRARED LUMINESCENCE FROM COLOURLESS CUBIC ZIRCONIA BY TIME-GATED IMAGING

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KEY WORDS: Instrumentation, fluorescence, luminescence, time-gated, diamond, cubic zirconia, simulants, diamond substitutes, real-time, near infrared, lifetime imaging, nitrogen vacancy centre, low-cost

Abstract: In our recent publication, a long-lived ms decay luminescing in the near infrared >800 nm present in productions of ‘white’ colourless, faceted yttrium stabilized cubic zirconia (see figure 1a) is observed using time-resolved imaging [1]. The spectral signature of the strong luminescing feature also has characteristics of some trace impurities such as Neodymium (Nd³⁺) and has a complex exponential decay behaviour. Real-time detection of cubic zirconia mounted in diamond jewellery containing very small stones ($\leq 2e^{-6}$ kg or ≤ 0.01 ct) is possible, where observation by loupe is more challenging or other conventional techniques impractical and or slow to implement.

The short-wave infrared emission observed can be excited using a low-cost and safe visible green ring LED light source and the time-gated imaging of the luminescence using a machine vision monochrome camera (see figure 1b). The combination of near infrared and time-gated detection used with other standard verification instruments increases the robustness of verifying diamond parcels.

Many of the larger jewellery manufacturers still see imitation diamonds as a significant threat (again particularly in the small sizes) in their pipeline, as in a lot of cases, CZ is deliberately used in jewellery modelling as a substitute for diamond to test settings.

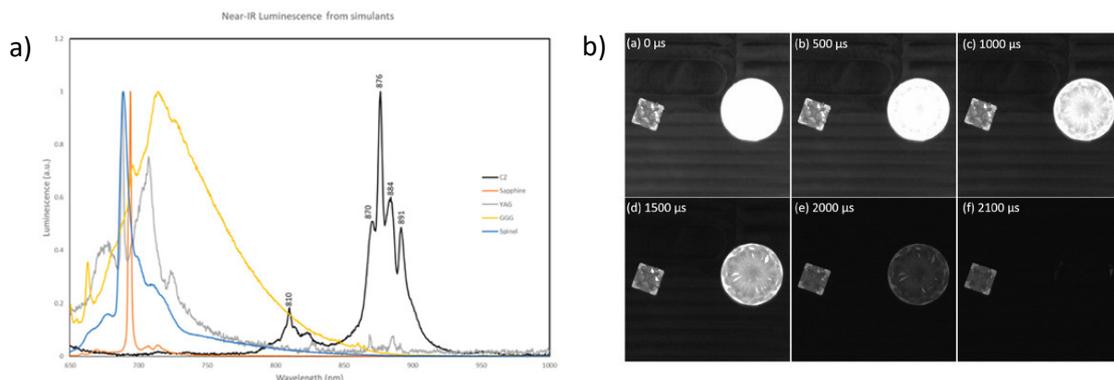


Figure 1. Reproduced from [1], (a) luminescence spectra of common diamond imitations, (b) real-time image capture of round brilliant diamond (1 ct) and square-shaped CZ (Princess-cut) of 2.75 mm, with increasing exposure delay, shown in μ s.

[1] P. M. P. Lanigan, C. D. McGuinness, M. Rendle, P. A. Aked, C. G. Bearcroft, D. C. Jones and S. C. Lawson, "Real-Time Detection of Long Lived Near Infrared luminescence from Colourless Cubic Zirconia by Time-Gated Imaging," *Minerals: Special Issue Gemstone Analysis by Spectroscopy and Microscopy*, **10**(10), 891 (2020).