xCLent - Application Note

Diamond composite analysis

Most diamond composites are manufactured via high pressure, high temperature sintering processes. In industrial applications, the composite is produced integrally with a cemented tungsten carbide substrate. The diamond is highly cathodoluminescent active and often shows structure.

There are three broad bands in the cathodoluminescence spectra of diamond, with differing proportions of the bands in differing composites. By setting windows within each of these bands it is possible to map out the location and distribution of the source regions of these bands. By colour coding bands A, B and C within the spectra with the primary red-blue-green colours, both the distribution and concentration of the defect structures in the samples can be mapped. This process is illustrated in Fig. 1 and Fig. 2. These broad bands have the following characteristics:

- Band A: peak at ~447 nm (2.78 eV) with FWHM ~75 nm
- Band B: peak at ~517 nm (2.40 eV) and FWHM ~ 60 nm
- Band C: "flat peak" ranging from 576 to 626 nm (2.16-1.98 eV) and FWHM ~100 nm

Within the optical region 350 to 800 nm, there are approximately 54 vibronic bands that are cathodoluminescence related. Band A is the most commonly observed cathodoluminescence emission from diamond but the assignment of the wavelength or energy spread for this band seems to be inconsistent. These studies suggest that the broad band centred about 600 nm is consistent with several overlapping peaks. Finally the band at ~517 nm has been assigned to intrinsic interstitials within the diamond.

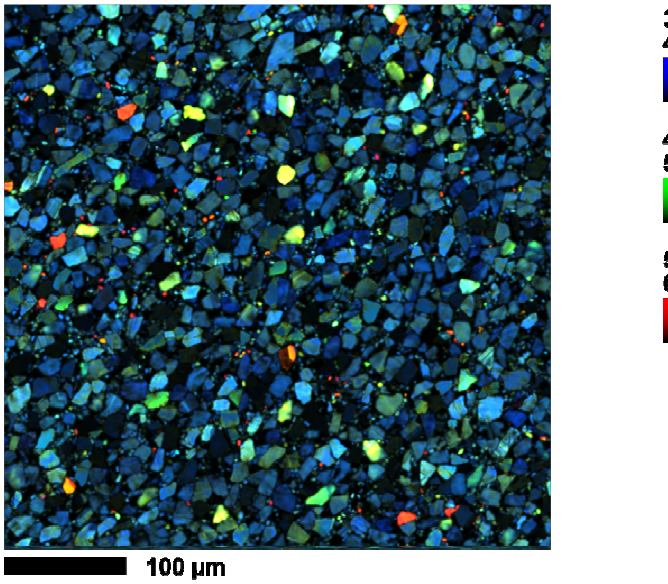

Figure 1.

Hyperspectral cathodoluminescence map of diamond composite, DC3, showing different bands within the diamond grains.

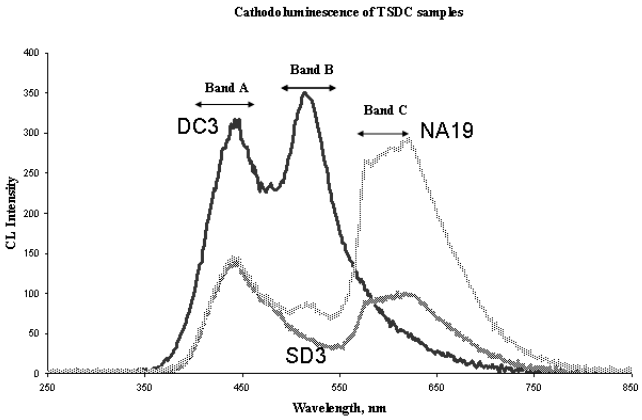

Figure 2.

Cathodoluminescence spectrum from composite diamond samples with the broad bands A, B and C identified.

Reference:

1. J N Boland, X Li, C MacRae, N Wilson, "Wear of diamond composites in hard rock cutting", Euro PM2006, Belgium 2006.