

cuboid sectors. This difference would cause $\{111\}$ sectors to produce a relatively stronger emission of the N3 vibronic system, ZPL 415 nm, which is excited both in CL and PL [1,2], but this explanation has not yet been experimentally verified by point-by-point CL spectroscopic probing in the case of SL-00/47. On the other hand the yellow-green luminescence systems observed from cuboid growth, including those in Table 1, are much more efficiently excited by UV than by electron irradiation. Consequently, one would expect a UV-excited PL topograph of SL-00/47 to be a better discriminator between $\{111\}$ and cuboid growth than a CL topograph. This expected behaviour is well exhibited in monochrome in Fig. 5b, where it can be directly compared with Figs. 5a and c; and colour (Fig. 6) is additionally informative. In the PL images the narrow vertical band of luminescence deficiency between $[100]$ and $[010]$ -directed cuboid sectors is striking: it results from the sub-surface sheetwise extension of the (111) -faceted sector that forms the narrow, $[110]$ -pointing outcrop strip on Fig. 5a, and it may also include at depth a sheet of growth on $(11\bar{1})$. The colour reproduction Fig. 6



Fig. 6. Colour micrograph of core PL, 325nm excitation, recorded on Kodak Gold 200.

shows clearly that it is the yellow-green PL that is here deficient, not the blue of the N3 system.

4.3. Infrared absorption

Two methods were used to obtain infrared absorption spectra, serving different purposes. The first provided an overall measure of the strikingly different absorption properties of the luminescent core compared with its enclosing shells of normal $\{111\}$ -faceted growth. This was achieved by appropriately positioning on the (001) -polished surface a thin metal mask with a central 0.6 mm diameter aperture and recording transmission through the aperture using a Nicolet 510P FTIR spectrometer with condenser accessory. In the first mask position the aperture fell wholly within the core outcrop boundary. In the second position the aperture was displaced 1 mm in the $[\bar{1}10]$ direction, i.e. leftwards in Figs. 2 and 3. It then covered zones of lowest N impurity concentration, as judged by CL. The spectra obtained by this procedure will be referred to as 'spot' measurements. To obtain more spatial detail, the second method used a Bruker IFS 113 FTIR spectrometer plus optical microscope combination, enabling spectra to be recorded step-wise along selected trajectories on the (001) face. The specimen translation steps were 150 μm , the sampling beam diameter 100 μm , and 2 trajectories were taken. Trajectory 1 scanned in the $[\bar{1}10]$ direction, running below the major crack as viewed in Fig. 2; trajectory 2 was diagonal, roughly $[\bar{1}00]$, passing over the centre of the luminescent core. Spectra were recorded with 2 cm^{-1} resolution by both spectrometers.

To find the concentrations of N aggregated into A and B defects, N_A and N_B , respectively, the observed spectra were separated into their component A- and B-defect spectrum contributions. Then the currently accepted conversion rates from these absorptions to N_A [38] and N_B [39] were applied. For the core, average values given by the spot measurement were, in round figures, 15 atomic ppm N_A and 600 atomic ppm N_B . This N_A/N_B ratio is very low; N_B is high but not exceptionally so. The spot measurement in the $\{111\}$ -faceted area gave $N_A \sim 25$ atomic ppm,