Peculiar defect emissions of time-dependent XEOL from sapphire wafers

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Abstract

The advantages of X-ray nanobeam operating in hybrid bunch mode can provide not only a sufficiently high peak power density but also high-quality temporal domain measurements for studying the luminescence dynamics of materials. Based on the advantages, the optical properties of *c*-, *a*-, *r*- and *m*-plane sapphire wafers have been studied using X-ray excited optical luminescence (XEOL) with nano-focused X-ray beams. We observed the well-known sapphire defect emissions, a broad emission at 330 nm and a sharp emission at around 700 nm, which were attributed to F^+ center and Cr^{3+} impurities, respectively. However, the F^+ center emission exhibited a peculiar behavior that the emission intensity increased with X-ray irradiation time. This behavior was only influenced by X-ray peak power density, regardless of X-ray energy. When the peak power density was lowered using an attenuator, the intensity of F^+ center no longer increased with X-ray irradiation time. Detailed results of the experiemnts will be reported.