Dynamical processes and transient structures underlying energy conversion: x-ray spectroscopies from fs to μs

Capabilities of XEOL and TR-XEOL of TPS 23A X-ray nanoprobe via hybrid bunch mode

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X-ray excited optical luminescence (XEOL) and Time-resolved XEOL (TR-XEOL) were developed successfully for the 23A X-ray nanoprobe beamline located at the Taiwan Photon Source (TPS). The advantages of the TR-XEOL include (i) a nano-focused X-ray beam (<60 nm) with excellent spatial resolution and (ii) a streak camera that can simultaneously record the XEOL spectrum and decay lifetime.[1] Especially, using an x-ray nanobeam operating in the hybrid bunch mode will provide not only a sufficiently high peak power density but also high-quality temporal domain (~ 200 ns) measurements for studying the luminescence dynamics of materials. The peculiar emission behavior has been observed in nonpolar a-plane MgZnO/ZnO multiple quantum wells (MQWs): the emission intensity increases more than 10 times after X-ray irradiation.[2] In addition, the X-ray fluorescence (XRF) of TPS 23A also can provide the visualization methods for the characterization of valence states in phosphor materials, such as Eu-doped BaAl2O4. XRF mapping not only gives information on the elemental distributions but also clearly reveals the valence state distributions of the Eu2+ and Eu3+ ions.[3]

We anticipate that X-ray nanoprobes will open new avenues with significant characterization ability for unravelling the emission mechanisms of light-emitting materials.

Figure 1. XEOL mapping (a) before and (b) after using the X-ray nanobeam patterning.[2]