Multifunctional Hard X-ray Nanoprobe: TR-XEOL and XEOL

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Abstract

Time-resolved X-ray excited optical luminescence (TR-XEOL) and X-ray excited optical luminescence (XEOL) have been developed successfully at the TPS 23A X-ray Nanoprobe (XNP) beamline at Taiwan Photon Source (TPS). Not only the TR-XEOL and XEOL, the multifunctional XNP with hard X-ray energy range (4-15 keV) but also includes other featured methods, such as X-ray absorption spectroscopy (XAS), X-ray fluorescence (XRF), cathodoluminescence (CL), X-ray diffraction (XRD) and Bragg ptychography. Based the temporal and high spatial resolution, so that the XNP in a single probe can simultaneously obtain the compositional, optical and structural information.

Advanced by energy-tunable hard X-rays, the XNP at TPS provides 40nm spatially resolving means for investigating the optical properties of specific elements in the novel luminescent materials, such as trihalide perovskite and wide bandgap semiconductors. An ultrafast streak camera is synchronized with the pulse structure of the synchrotron ring to investigate the dynamics of luminescence of the materials with temporal resolution 30 ps ~ 1.72 μs in the single bunch mode. In parallel to the construction of the XNP endstation, demonstrative XEOL experiments were studied by unfocused X-ray beam at Taiwan Light Source (TLS). Temperature dependent XEOL and polarization-dependent XEOL were used to study the peculiar near-band-edge (NBE) emission of c-plane and a-plane ZnO wafers, respectively. The detail design of the TR-XEOL and XEOL at XNP, and the demonstrative experimental results of trihalide perovskite $CH_3NH_3PbBr_3$ and a single ZnO microrod will be reported.