NIR-responsive phosphors for anti-counterfeiting applications

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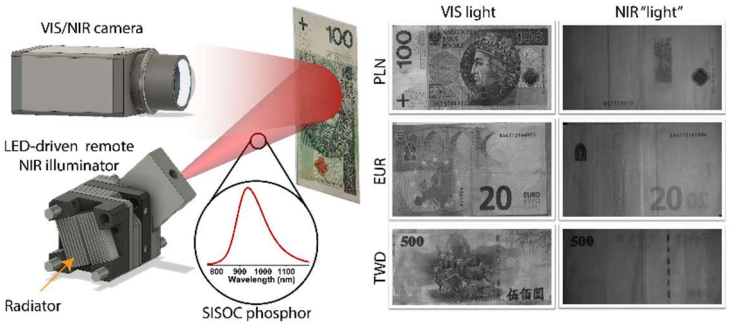
Chromium-activated oxide double perovskites are emerging as promising broadband near-infrared emitters, but achieving strong NIR emission together with high thermal stability remains a key challenge. In this work, we investigate site-engineered $Sr_{2(1-x)}Ba_{2x}InSbO_6$ doped with Cr^{3+} and demonstrate how symmetry control of the host lattice governs crystal-field strength, local disorder, and the photophysical behavior of chromium ions. Synchrotron X-ray diffraction and Raman spectroscopy reveal a continuous structural evolution from monoclinic Sr2InSbO6 to an almost cubic Ba2InSbO6, leading to a systematic infrared shift of the NIR emission. Temperature-dependent luminescence shows that Sr-rich compositions exhibit outstanding thermal stability, exceeding that of recently reported chromium-activated chloride double perovskites. Configuration-coordinate analysis identifies self-trapped-exciton-assisted relaxation as the dominant nonradiative pathway, while crossover and autoionization mechanisms are excluded, providing a unified microscopic picture of thermal quenching in oxide double perovskites. Finally, exploiting the robust NIR performance of Sr2InSbO6 doped with chromium, we demonstrate a remote LED-driven NIR illuminator in which the phosphor is spatially separated from the excitation source to reduce thermal load. The device delivers intense and uniform NIR emission and enables visualization of hidden security features in banknotes, highlighting its potential for compact anti-counterfeiting applications.



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