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High-bitrate visible light communication and high-quality solid-state lighting using superluminescent diode

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ABSTRACT

White light solid-state lighting (SSL) is conventionally based on light-emitting diodes (LEDs). Endless applications rely on this technology while further explorations are being made towards smart lighting and visible light communications (VLC). On the other hand, laser diodes (LDs) have been proposed as a substitute to LEDs due to their higher energy efficiency, output power, and VLC data rates; however, laser radiation and eye-safety are always a concern. As an alternative solution, superluminescent diodes (SLDs) bring together low coherency and high power, high efficiency and low speckle density, offering the benefits of both LEDs and LDs. Here, a blue SLD with broad spectral bandwidth (~6 nm) and high power (>100 mW) is used to demonstrate high-quality warm-white light with a high CRI of 85 and a CCT of ~3400 K. Our SLD based on a ridge-waveguide and tilted facet shows a spectral bandwidth of ~6 nm across different injection currents allowing the generation of stable CRI values through various light intensities. We compare LED, LD, and SLD emitting at ~450 nm, discussing the electro-optical properties as well as the analysis of the generated white light and VLC capabilities at different operating conditions. Our results demonstrate high-quality white light and gigabit-per-second VLC based on SLD. Moreover, our device fabricated in a commercially available c-plane InGaN-based device-platform constitutes a viable innovation for the lighting industry and a step ahead towards the adoption of blue SLD for commercial applications.

Keywords: superluminescent diode, gallium nitride, InGaN, solid-state lighting, visible light communications, light emitting diode, white light.