Superluminescent diode offers broad emission

Opt. Express **16,** 16860–16866 (2008)

Researchers in Taiwan have demonstrated a GaAs-based transverse-junction superluminescent diode (SLED) that operates at a wavelength of 1.1 μm, which corresponds to the quantum wells buried in the centre of the active region. This is in contrast to conventional vertical-junction SLEDs whose electroluminescent spectrum is governed by quantum wells closest to the topmost p-side cladding layer.

The device is aimed at optical coherence tomography applications where a broadband and high-power SLED serves as the key component for improving system resolution. Because of their design, conventional vertical-junction SLEDs have a limited maximum bandwidth.

Shi-Hao Guol and colleagues from the National Taiwan University, National Central University and LandMark Optoelectronics Corporation claim that their device is different from conventional vertical-junction white-light SLEDs in that the uniform distribution of injected carriers among different multiple quantum wells is significantly improved.

In the transverse-junction SLED, superluminescence is dominated by the quantum wells in the centre of the active region rather than those located near to the p-type cladding layer.

MEMS-tuning scheme aids short-wavelength VCSELs

Opt. Express **16,** 16093–16103 (2008)

Vertical-cavity surface-emitting lasers (VCSELs) that operate at short wavelengths and are tuned by microelectromechanical system (MEMS) technology have been developed by US researchers.

The team from the Lawrence Livermore National Laboratory and the University of Illinois at Urbana-Champaign, USA, says that its devices have emission wavelengths shorter than 800 nm and suit use as high-speed tunable sources for oxygen detection.

The MEMS-VCSELS are fully monolithic and are based on an oxide-aperture AlGaAs epitaxial structure with a suspended dielectric Bragg mirror for wavelength tuning. By implementing electrostatic actuation, the researchers demonstrated the potential for tuning rates up to 1 MHz, as well as a wide wavelength tuning range of 30 nm (767–737 nm).

The fabrication procedure is a relatively complex process involving up to 12 lithographic levels for wire-bonded devices. The group used gas-phase etching of a room-temperature-deposited amorphous germanium sacrificial layer to generate the suspended mirror.

The researchers believe that with minor improvements in the epitaxial materials and suspended mirror structure, it should be possible to demonstrate high-performance VCSELs with tuning ranges in excess of 4% of the emission wavelength near 760 nm.

Near-infrared diodes reach output power milestone

Photon. Technol. Lett. **20,** 1766–1768 (2008)

High-temperature, high-power operation of GaInNAs laser diodes in the 1,220–1,240 nm wavelength range has been demonstrated by researchers in Germany and Poland.

Dirk Bisping and colleagues from the University of Würzburg, Germany, University of Technology, Wroclaw, Poland, and Nanoplus, Gerbrunn, Germany, say their devices have the highest continuous-wave room-temperature output power (8.9 W) reported so far in this wavelength range.

The GaInNAs quantum-well-based structure features a large optical cavity that significantly decreases the internal loss of the laser structure. The researchers report internal losses about one-sixth that of a conventional cavity design.

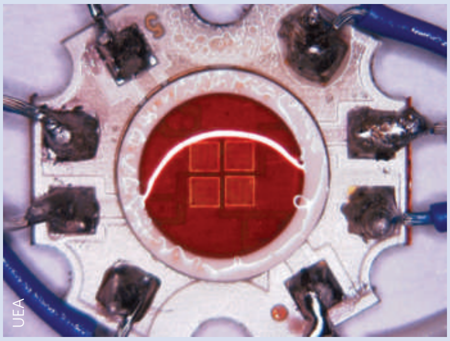
The devices can also operate at high power in temperatures up to 120 °C with output powers of more than 4 W up to 90 °C.

Red nanocrystals address white LED colour problem

Adv. Mater. **20,** 1–6 (2008)

A group of researchers from the UK and Germany have used InP nanocrystals to improve the colour-rendering properties of white light-emitting diodes (LEDs). Most commercially available white LEDs use additive colour mixing, where the emissions from differently coloured light sources combine to form white light.

One form of colour mixing is called down-conversion, where an LED uses a blue LED chip with an additional polymer layer containing yellow-emitting converter material. However, these LEDs are still significantly more expensive than incandescent light bulbs, and, like most fluorescent lamps, emit a bluish, cold white light, with poor colour-rendering properties. The poor quality of the white light perceived originates in the yellow converter material, YAG:Ce, owing to its lack of emission in the green and red parts of the spectrum.


UEA

Researchers from the University of East Anglia (UEA; UK), University of Erlangen, Germany and PerkinElmer Elcos, Germany, have now corrected the emission spectrum of YAG:Ce by adding red-emitting InP-based nanocrystals to the design.

These nanocrystals require stabilization in the host material to prevent the formation of non-emissive nanoparticle agglomerates. However, the surface-bound ligands that are used for stabilization during typical InP synthesis hamper polymerization and can degrade the mechanical stability of the converter and polymer composite.

"To solve this problem we coated the InP nanocrystals with ZnS and then added an additional silica shell prior to combining them with the silicone polymer," explains Professor Thomas Nann from UEA. "The ZnS shell protects the InP core from chemical or optical attack, prevents the core from binding to other atoms and, as ZnS is a wide-bandgap semiconductor, it confines the excitons into the InP core. The silica shell removes the ligands and therefore makes the nanocrystals compatible with the silicone."

The resulting converter/polymer composite is clear, allowing efficient emission of light without scattering. "In comparison with commercially available white LEDs, the emitted light is tunable and more optically pleasing because it is more similar to sunlight," says Nann. "We hope that our industrial partner in this project, Perkin Elmer, will commercialize the new LEDs."