New semiconductor light source boosts the laser signal strength and quality of optical data networks in military tactical engagement systems

UCF researchers have invented technologies that enable manufacturers to create faster, more efficient semiconductor light sources than those currently used in optical data networks and other data communication systems. Besides boosting the speed and quality of a network’s laser beam signals, the Diffused Channel Semiconductor Light Sources technology minimizes the self-heating, signal degradation and interference issues associated with other kinds of data network light sources, such as vertical cavity surface emitting lasers (VCSELs) and resonant cavity light-emitting diodes (RCLEDs).

High-speed optical data networks typically use semiconductor light sources, including VCSELs and RCLEDs to generate the light used to carry optical signals through an optical medium from a transmitter to a receiver. Such networks support military applications such as simulating weaponry, training soldiers, combat identification of friend or foe, and other applications. However, many lasers for these systems produce speckle and scintillation—interference effects that cause signal degradation. Additionally, when laser diodes run at high power, they are susceptible to self-heating and tend to operate in multitransverse modes, which further degrade system performance and beam quality. By providing better current blocking and mode confinement, the new UCF light sources minimize such performance issues and enable networks to transmit and receive data with higher fidelity, speed and efficiency.

Technical Details

The invention comprises a semiconductor vertical resonant cavity light source with an active region located between upper and lower mirrors, an inner mode confinement region, and an outer current blocking region. At least one cavity spacer layer lies between the current blocking region and the active region. The upper mirror comprises a p-type distributed Bragg reflector (DBR) and the lower mirror comprises an n-type DBR. Within the inner mode confinement region, is a conducting channel framed by a depleted heterojunction current blocking region (DHCBR). The conducting channel includes impurity doping that increases its electrical conductivity within the inner mode confinement region. When the light source is operating, the DHCBR forces the current flow into the conducting channel.
Besides the vertical resonant cavity light source design, the invention also encompasses examples for using the light source to improve laser transmitters and tactical engagement systems with VCSELS that use DHCBRs.

Benefits

- Minimizes internal self-heating within high-speed optical networks
- Enables networks to be made reliably with uniform size into arrays
- Supports the production of single mode emission to increase the maximum fiber distance for data transmission
- Enables high-power arrays to interconnect vertical resonant cavity light sources

Applications

- Military applications (simulating weaponry, training soldiers, combat identification)
- Light Detection and Ranging (lidar) for mapping or position sensing
- Non-military tactical engagement systems, such as gaming programs
- High-power pumping

Note: this technology relates to the following UCF ID#s: 33707, 33708, 33711, 33712

Inventions 33707 and 33711 pertain to vertical-cavity semiconductor heterostructure devices with depleted heterojunction current blocking regions (DHCBRs). The DHCBRs include a depleting impurity specie within the outer current blocking region to achieve electrical and optical confinement, high reliability and good heat flow.

Inventions 33708 and 33712 pertain to vertical resonant cavity light sources, such as VCSELS, RCLEDs, or surface-emitting LEDs. Impurity regions placed in cavity spacers control the electrical conductivity in and around an injection region to the light emission region of the device. The electrical conductivity is controlled by epitaxial confinement structures to provide very low electrical resistance under normal device operation by forming a PNPN blocking region in an outer current blocking region with a conducting channel in an inner mode confinement region.

Technology #33264

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