Opto-Electronic Advances

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Contents

Review

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The team of Academician Yue Hao and Professor Genquan Han from Xidian University has long been committed to germanium-tin material and device. They have done a lot of innovative work in high performance GeSn-based CMOS, Beyond CMOS and GeSn photonic devices in middle infrared domain through theory and experiment. The performance of photonic devices based on GeSn can be improved by adjusting its band structure. By incorporating Sn into Ge, GeSn becomes a direct bandgap material and the strain is introduced to achieve the indirect-to-direct transition without increasing the requirement for Sn composition. The strain induced in GeSn material reduces the $E_{G,\Gamma}$ due to the shift of Γ conduction valley down and HH band up, which is conducive to red shift of absorption edge. The cut-off wavelength of the proposed pillar detector can be extended to 4.35 μm. In the laser applications, a biaxial tensile strain is introduced into the GeSn/SiGeSn multiple quantum well (MQW) laser by the Si_3N_4 liner stressor. The increase of electron occupation probability in Γ conduction valley is conducive to the improvement of optical emission performance in lasers, which can be achieved by increasing Sn content. The proposed laser shows a J_{th} reduction from 476 to 168 A/cm^2 and a significant enhancement of optical gain. The proposed strategy will promote the development of optoelectronics applications in mid-infrared (MIR) wavelength.

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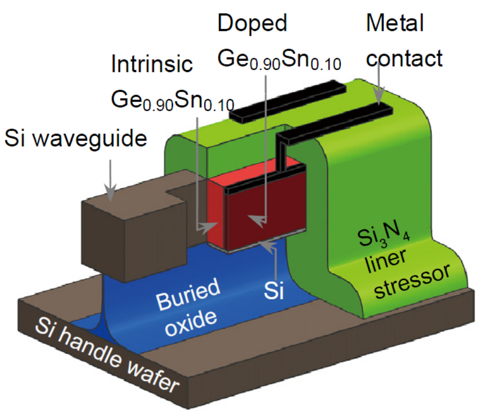

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Review

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As the main transmitter for the intra-data-center link, the 850-nm vertical cavity surface emitting laser (VCSEL) array module is standardized toward 100/200/400 Gbps or beyond, which effectively increases the cloud transmission rate in data centers to meet the urgent demands on huge amount of audio/video/data exchange and streaming nowadays. It has been scheduled to apply the 400-Gbps VCSEL optical transceiver module for the cloud data center applications in 2020. On the other hand, the 940-nm VCSEL array has also emerged for comprehensive contour mapping or range sensing applications built-in with portable and handheld devices, such as the face recognition in mobile phone and tablet, and the distance and geomorphological sensing in LiDAR for unmanned vehicles. Three teams from National Taiwan University and National Chiao Tung University review the state-of-the-art of the high-speed 850/940-nm VCSEL, discussing the structural design, mode control and the related data transmission performance. InGaAs/AlGaAs MQW was used to increase the differential gain and photon density in VCSEL. The multiple oxide layers and oxide-confined aperture were well designed in VCSEL to decrease the parasitic capacitance and generate single mode (SM) VCSEL. The maximal modulation bandwidth of 30 GHz was achieved with well-designed VCSEL structure. Other applications of the near-infrared VCSELs are discussed at the end of the paper.

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