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Editorial

Editorial for Special Issue "Frontiers of Semiconductor Lasers"

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Since the end of the last century, in which semiconductor lasers were fast developing, this kind of laser and its applications have greatly improved our world. Semiconductor lasers are carriers of both energy for industry and information for optical communications. The recent progress in research on semiconductor lasers has offered new perspective regarding both their material growth and structural design. In this Special Issue of *Crystals*, we have gathered twelve peer-reviewed papers that shed light on recent advances in the field of semiconductor lasers and their applications.

Shunhua Wu et al. reported on the theoretical and experimental lasing performance of a 2 mm laser bar. [1]. An experimental electro-optical conversion efficiency of 71% was demonstrated, with a slope efficiency of 1.34 W/A and an injection current of 600 A at a heatsink temperature of 223 K. Qiaoxia Gong et al. established a thermal–structural coupling model and analyzed the influences of the pump power, cavity structure, and crystal size [2]. The highest temperature rise was also analyzed. Meanwhile, increasing the curvature radius of the cavity mirror and the length and width of the crystal, or decreasing the thickness of the crystal, was also found to be beneficial. Jinliang Han et al. reported a method of compressing the spectral linewidth and tuning the central wavelength of multiple high-power diode laser arrays in an external cavity feedback structure based on one volume Bragg grating (VBG) [3]. A diode laser source producing 102.1 W at an operating current of 40 A was achieved using a combination of beam collimation and spatial beam technologies. Moreover, a tuning central wavelength ranging from 776 to 766.231 nm was realized by precisely controlling the temperature of the VBG, and the locked central wavelength, as a function of temperature, shifted at a rate of approximately 0.0076 nm/°C. Zhuo Zhang et al. designed an ultra-long stable oscillating laser cavity with a transmission distance of 10 m [4]. The proposed wireless energy transmission scheme based on a VECSEL laser is the first of its kind to yield a 1.5 m transmission distance output power that exceeds 2.5 W. Yuhang Ma et al. reviewed the progress in the development and application of external cavity quantum cascade lasers [5]. Nan Zhang et al. discussed the merits of solution-processed perovskite semiconductors as lasing gain materials and summarized the characteristics of a variety of perovskite lasers [6]. Yanxin Shen et al. reviewed the 1.3 μm laser crystals and the progress made in their research, as well as some new optical crystals and novel materials [7]. Bin Wang et al. reviewed the principles of selective area epitaxy, including growth rate enhancement, composition variation, the vapor phase diffusion model, and bandgap engineering, as well as its applications, such as BH lasers, QD lasers, heteroepitaxial lasers on Si, EML, and MWLA, which are introduced in detail [8]. Shen Niu et al. briefly introduced the properties and working principles of the DFB laser array [9]. Keke Ding et al. reviewed the narrow linewidth external cavity semiconductor laser [10]. Yue Song et al. reviewed the reliability issues affecting semiconductor lasers throughout the whole supply chain, including the failure modes and causes of failure for high-power semiconductor lasers, the principles and application status of accelerated aging experiments and lifetime evaluation, and common techniques used for high-power semiconductor laser failure analysis [11]. Xuan Li reviewed two main device-integrated

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structures for achieving widely tunable, narrow-linewidth external cavity lasers on silicon substrates, such as the MRR-integrated structure and MRR–MZI-integrated structure of external cavity semiconductor lasers. The results show that the silicon-substrate-integrated external cavity lasers offer a potential way to realize a wide tuning range, high power, single mode, stable spectral output, and high side mode suppression ratio laser output. [12].

As shown in this Special Issue of *Crystals*, the study of semiconductor lasers and their applications continues to grow and expand as we, as a community, strive to acquire further understanding of the underlying potential of these lasers. The goal of this Special Issue is to bring these and other new concepts closer to application in the field of semiconductor lasers and beyond.

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References

1. Wu, S.; Li, T.; Wang, Z.; Chen, L.; Zhang, J.; Zhang, J.; Liu, J.; Zhang, Y.; Deng, L. Study of Temperature Effects on the Design of Active Region for 808 nm High-Power Semiconductor Laser. *Crystals* **2023**, *13*, 85. [CrossRef]
2. Gong, Q.; Zhang, M.; Lin, C.; Yang, X.; Fu, X.; Ma, F.; Hu, Y.; Dong, L.; Shan, C. Analysis of Thermal Effects in Kilowatt High Power Diamond Raman Lasers. *Crystals* **2022**, *12*, 1824. [CrossRef]
3. Han, J.; Zhang, J.; Shan, X.; Zhang, Y.; Peng, H.; Qin, L.; Wang, L. Tunable, High-Power, Narrow-Linewidth Diode Laser for Potassium Alkali Metal Vapor Laser Pumping. *Crystals* **2022**, *12*, 1675. [CrossRef]
4. Zhang, Z.; Zhang, J.; Gong, Y.; Zhou, Y.; Zhang, X.; Chen, C.; Wu, H.; Chen, Y.; Qin, L.; Ning, Y. Long-Distance High-Power Wireless Optical Energy Transmission Based on VECSELs. *Crystals* **2022**, *12*, 1475. [CrossRef]
5. Ma, Y.; Ding, K.; Wei, L.; Li, X.; Shi, J.; Li, Z.; Qu, Y.; Li, L.; Qiao, Z.; Liu, G.; et al. Research on Mid-Infrared External Cavity Quantum Cascade Lasers and Applications. *Crystals* **2022**, *12*, 1564. [CrossRef]
6. Zhang, N.; Na, Q.; Xie, Q.; Jia, S. Development of Solution-Processed Perovskite Semiconductors Lasers. *Crystals* **2022**, *12*, 1274. [CrossRef]
7. Shen, Y.; Fu, X.; Yao, C.; Li, W.; Wang, Y.; Zhao, X.; Fu, X.; Ning, Y. Optical Crystals for 1.3 μm All-Solid-State Passively Q-Switched Laser. *Crystals* **2022**, *12*, 1060. [CrossRef]
8. Wang, B.; Zeng, Y.; Song, Y.; Wang, Y.; Liang, L.; Qin, L.; Zhang, J.; Jia, P.; Lei, Y.; Qiu, C.; et al. Principles of Selective Area Epitaxy and Applications in III–V Semiconductor Lasers Using MOCVD: A Review. *Crystals* **2022**, *12*, 1011. [CrossRef]
9. Niu, S.; Song, Y.; Zhang, L.; Chen, Y.; Liang, L.; Wang, Y.; Qin, L.; Jia, P.; Qiu, C.; Lei, Y.; et al. Research Progress of Monolithic Integrated DFB Laser Arrays for Optical Communication. *Crystals* **2022**, *12*, 1006. [CrossRef]
10. Ding, K.; Ma, Y.; Wei, L.; Li, X.; Shi, J.; Li, Z.; Qu, Y.; Li, L.; Qiao, Z.; Liu, G.; et al. Research on Narrow Linewidth External Cavity Semiconductor Lasers. *Crystals* **2022**, *12*, 956. [CrossRef]
11. Song, Y.; Lv, Z.; Bai, J.; Niu, S.; Wu, Z.; Qin, L.; Chen, Y.; Liang, L.; Lei, Y.; Jia, P.; et al. Processes of the Reliability and Degradation Mechanism of High-Power Semiconductor Lasers. *Crystals* **2022**, *12*, 765. [CrossRef]
12. Li, X.; Shi, J.; Wei, L.; Ding, K.; Ma, Y.; Li, Z.; Li, L.; Qu, Y.; Qiao, Z.; Liu, G.; et al. Research on Silicon-Substrate-Integrated Widely Tunable, Narrow Linewidth External Cavity Lasers. *Crystals* **2022**, *12*, 674. [CrossRef]