EDITORIAL

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Preface to the Special Topic on Compound Semiconductor Materials and Devices on Si

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The research in silicon photonics has been booming due to its potential for low-cost, reliable, energy-efficient and high-density chip-wise integration using widely available CMOS technology, featuring the tremendous success in modulator, detector and other passive waveguide components in industry. However, the absence of efficient and reliable electrical to optical converter on Si platform has been considered as "the last piece of the puzzle", hindered by the in-direct bandgap property of Si bulk materials. Compound III–V semiconductor devices offer highly efficient optical light emitting sources and optical amplifiers, hence the compound semiconductor materials and devices on Si platform are drawing more and more attention nowadays as it could make possible the long-dreamed light sources on Si substrates by combining their advantages with silicon ICs, enabling the fabrication of full functional optoelectronic circuits, chip-to-chip and even system-to-system optical chips. Although the material dissimilarity between III–V compound material and Si has impeded the integration development for over 30 years, considerable breakthroughs happened in recent years and revived our understanding of this field, providing both opportunities and challenges in the ultimate completion of silicon photonics era.

Here we organize a special topic of "Compound Semiconductor Materials and Devices on Si" in *Journal of Semiconductors*, including the contributions of 6 groups of researchers in this fields. We aim to cover the state-of-art research highlights and directions of compound III–V materials on Si, their electronic and optoelectronic physics and devices. Firstly, we have one review paper overviewing the III–V compound materials and lasers on silicon, describing the three main integration methods and comparing their performance. Then we have three in-depth review papers covering the up-to-date III–V quantum-dot materials on silicon substrate detailing from the fabrication, structures, dynamics to applications. In addition, one review paper reports the recent progress on ternary III–V nanowires (NWs) on Si substrates for lasers, solar cells, water splitting devices, photodetectors and FETs. We also have one review paper focusing on the bonding method and identifying recent novel heterogeneously integrated Si lasers for emerging applications like spectroscopy, sensing, metrology and microwave photonics. Finally, the challenges and opportunities of heterogeneous integration approach are discussed.

We sincerely hope that this special topic could provide valuable information and perspective to the research community working on the topic of compound semiconductor materials on Si and inspire many more to enter the related fields. We would like to thank all the authors who have contributed high-quality peer-reviewed articles to this special topic. We are also grateful to the editorial and production staff of *Journal of Semiconductors* for their high-quality assistance.