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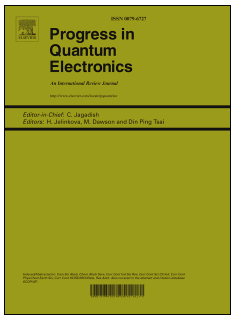

III-Nitride Nanowires on Unconventional Substrates: from Materials to Optoelectronic Device Applications

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III-Nitride Nanowires on Unconventional Substrates: from Materials to Optoelectronic Device Applications

Chao Zhao,[1] Nasir Alfaraj,[1] Ram Chandra Subedi, Jian Wei Liang, Abdullah A. Alatawi, Abdullah A Alhamoud, Mohamed Ebaid, Mohd Sharizal Alias, Tien Khee Ng, Boon S. Ooi**

King Abdullah University of Science and Technology (KAUST), Photonics Laboratory, Thuwal 23955-6900, Saudi Arabia

[*] E-mail: tienkhee.ng@kaust.edu.sa, boon.ooi@kaust.edu.sa
[1] Contribute equally to this work.

Group-III nitrides and their alloys feature direct bandgaps covering a broad range of the electromagnetic spectrum, making them a promising material system for various applications, such as solid state lighting, chemical/biological sensing, water splitting, medical diagnostics, and communications. In recent years, the growth of strain and defect-free group-III nitride vertical nanowires has exploded as an area of research. These nanowires, grown on various unconventional substrates, such as silicon and different metals, demonstrate potential advantages over their planar counterparts, including wavelength tunability to the near infrared and reduced efficiency droop. The low-profile and low power consumption of such nanowires also make them viable candidates for emerging applications, such as the Internet of things and artificial intelligence. Herein, we present a comprehensive review on the recent achievements made in the field of III-nitride nanowires. We compare and discuss the growth conditions and mechanisms involved in fabricating these structures via metalorganic chemical vapor deposition and molecular beam epitaxy. How the unique optical, electrical, and thermal properties of these nanowires are correlated with their growth conditions on various unconventional substrates is discussed, along with their respective applications, including light-emitting diodes, lasers, photodetectors, and photoelectrodes. Finally, we detail the remaining obstacles and challenges to fully exploit the potential of III-nitride nanowires for such practical applications.

Keywords: GaN nanowires, optoelectronics, light-emitting diode, laser, substrates