GaN versus ZnO: Growth, properties and applications

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GaN and ZnO are wide band gap semiconductor compounds with unique properties favourable for the development of short-wavelength light emitting devices and high-power electronics. From the point of view of applications, over the last decades gallium nitride proved to be more successful. In particular, GaN played a major role in the development of modern solid-state lighting industry, success that resulted in the Nobel Prize for Physics being awarded to Shuji Nakamura, Isamu Akasaki and Hiroshi Amano, in 2014. Note that a few years ago an electrically pumped inversionless polariton lasing at room temperature from a bulk GaN-based microcavity diode has been demonstrated [1,2]. Actually GaN is considered the second most important semiconductor material after Si, especially taking into account its utility for the development of high-frequency, high-power electronics. On the other hand, growing attention is paid nowadays to zinc oxide which exhibits direct band gap (E_g = 3.37 eV) close to that of GaN. The growing interest to ZnO is caused not only by the abundance of Zn element in Earth's crust, but also by the fascinating properties of crystalline material. For example, the binding energy of excitons in ZnO (60 meV) is considerably higher than in GaN (25 meV) which discloses the perspectives of zinc oxide for the development of cost-effective UV light-emitting devices. In this paper, we carry out a comparative analysis of the technologies for the growth and nanostructuring of GaN and ZnO, properties and applications in different fields, including optoelectronics, photonics and biomedicine. Besides, we review the recent development of various hybrid nanoarchitectures [3-5] for multifunctional applications.

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