



Nitrides as tools for solving global problems

大师讲堂

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Photo: Nagaoya University

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All are welcome.

Abstract: I believe that group III nitride semiconductors are among the most promising materials for solving global problems and realizing a sustainable society. GaN and related nitride materials have had a major impact on human lives. Their most important application is blue LEDs. Portable games machines and cellular or smart phones are very familiar items, especially to young people. Until the end of the 1990's, all the displays of portable games machines and cellular phones were monochrome. The younger generation can now enjoy full-color portable games and cellular/smart phones because of the emergence of blue LEDs. Today, applications of blue LEDs are not limited to displays. In combination with phosphors, blue LEDs can act as a white light source and are also used in general lighting. In Japan, about three-quarters of general lighting systems composed of incandescent and fluorescent lamps will have been replaced with LED lamp systems by 2020, by which we can reduce total electricity consumption by 7%, corresponding to a saving of 1 trillion JPY per year. AlGaN-based deep-UV LEDs are effective for the sterilization and purification of water. UNICEF reported that 663 million people still lack access to safe drinking water and 2.4 billion people do not use safe sanitation facilities. New water sterilization and purification systems have been commercialized in which high-power DUV LEDs are installed. Other applications of DUV LEDs include as a sterilizer for sanitation facilities, resins and the curing of inks, detecting forged banknotes, photolithography, and dermatology. This material system is also promising for electron devices. In mobile or smart phone base stations, high-frequency RF amplifiers employing GaAs-based heterojunction field-effect transistors (HFETs) are being replaced with those employing GaN-based HFETs because of their capability of higher-power operation. By replacing Si-based power devices such as insulated gate bipolar transistors or super-junction MOSFETs with GaN-based power devices, the average efficiency of inverters or converters can be improved from 95% to more than 99% in principle. As a result, we can expect an additional 9.8% reduction of electricity consumption.

To realize a sustainable society and social resources based on nitride semiconductor device and systems, we are facing several problems that must be solved. In this presentation, I would like to discuss the current status of our understanding of nitride semiconductors, especially the problems to be solved, and the prospects of their future application.

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