Ar Trumpabangiai UV Sviestukai Bus Sekanti Didele Sekme III-Nitridu Technologijoje?

Will Deep UV LEDs be a Next Big Thing in III-Nitride Technology?

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AlGaN emerged as a material system uniquely suited for fabrication of Deep Ultraviolet Light Emitting Diodes (DUVLEDs) with peak emission wavelengths from 210 nm to 340 nm and covering part of UV-A, UV-B and large part of UV-C. Note that these materials are also considered for DUV Laser Diodes.

Advances in AlGaN epitaxial layer growth technology, device designs, device fabrication and light extraction allowed to achieve external quantum efficiency and wall-plug efficiency in excess of 10% and 7% respectively [1]. These advances were followed by the development of manufacturing technology and, thus, currently DUVLEDs with peak emission in the range of 270nm -285 nm with output optical power of 2mW – 10mW are commercially available [2].

Most DUVLEDs are produced using standard Sapphire substrates. These substrates are transparent in UV but have a large lattice mismatch with AlN/AlGaN epitaxial layers. There is also a significantt effort to develop DUVLED technology using true bulk AlN substrates produced in the U.S. by Crytal IS, Inc. and Hexatech, Inc. It is expected that a much better latttice match with AlN/AlGaN epitaxial layers shoud significantly incease efficieny of DUVLEDs. However, so far bulk AlN substrates are produced in very limited quantities and have problems with transparency in DUV spectral range.

DUVLEDs are becoming an enabling platform for a broad range of applications in Military, National Security, Industrial and Commercial markets.

Few distinct types of applications that use DUVLEDs emitting in different DUV spectral ranges can be divided as follows:

- 280nm-340nm range. Used as fluorescence excitation sources for a wide variety of materials, including DNA containing materials. Two major programs focused on detection of weaponized bio-agents and harmful pathogens were funded by the Defense Advanced Project Agency (DARPA) in the period from 2004 to 2012 [3];
- 300nm-320nm. One of key applications is considered in medicine for skin treatment, for example, psioriasis;
- 265nm-280nm. Disinfection. Destruction of DNA in this spectral range enabels to eradicate bacteria, viruses and fungi in water, air and on the surface;
- 290nm-310nm. Food preservation. Extensive work was performed by a number of research groups in academia and various industries, including U.S. Department of Agriculture. It was confirmed that illumination in this range increase shelf-time of fresh produce few times;
- 250nm-260nm. Optical sensors for ozone detection;
- 215nm-225nm. Optical sensors for detection of such gases like NO, NO2, SO2, etc. in medicine and combustion systems.

These examples show potential of DUVLEDs in novel systems with potentially high volume applications. There numerous niche applications that successfully are using these devices with optimized specific peak emission wavelenghts.

Still, broad market penetration of DUVLEDs is waiting to happen. It will require further technology improvements, reduction of cost and multiple high volume DUVLED manufacaturers.

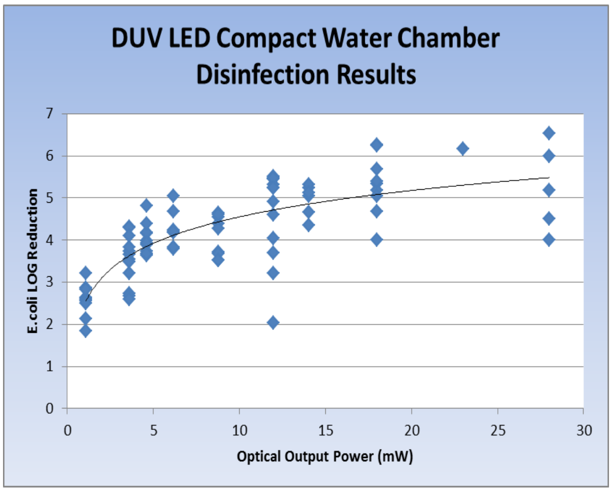

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Fig. 1. Eradication of *E-coli* in running water at 100 ml/minute using 275 nm DUVLEDs [4]. 6 Log reduction was achieved at DUVLED optical power less than 30 mW

References

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[3] DARPA SUVOS (2004-2008) and SMUVT (2008-2012)

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