Deep/Vacuum-UV AlN Light-Emitting Diode
～ New Exciton Emissions ～

SCIENCE PLAZA 2010

Motivation

Aluminum nitride (AlN) is a direct-bandgap semiconductor with the widest bandgap (6 eV) and an AlN light-emitting device is therefore expected to emit light with the shortest wavelength for semiconductors (Fig. 1). We reported a current-injected emission from AlN with a 210-nm wavelength, which is in the deep-UV (close to the vacuum-UV) region. AlN light-emitting devices will be used in environment and nanotechnology fields (Fig. 2).

Recently we have found that AlN has a unique physical property among semiconductors.

Originality

For an AlN light-emitting diode (LED), because the near-band-edge emission is strongly polarized, the emission intensity from the LED edge is one order of magnitude higher than that from the conventional LED surface (C-plane). This emission property is unique among semiconductors (Fig. 3).

The strongly polarized near-band-edge (exciton) emission originates from a unique valence band structure (negative crystal-field splitting energy), which is attributed to the large ionicity of AlN (Fig. 4).

Impact

From an AlN LED with improved emission intensity, in addition to A-exciton emission at 207.8 nm, B/C-exciton emission was observed at 199.5 nm (Fig. 5), which supports the valence band structure of AlN we clarified.

Because the valence band structure characterizes fundamental optical and electrical properties, our results are very useful for designing AlN-based light-emitting devices and realizing the deep-UV LEDs.

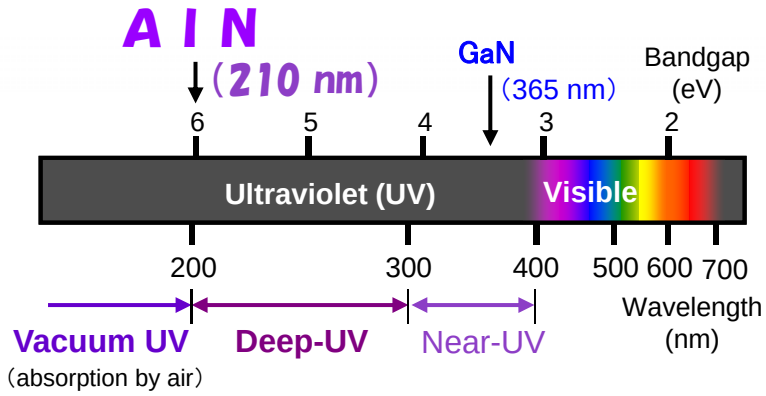

Fig. 1. Characteristics of aluminum nitride (AlN)

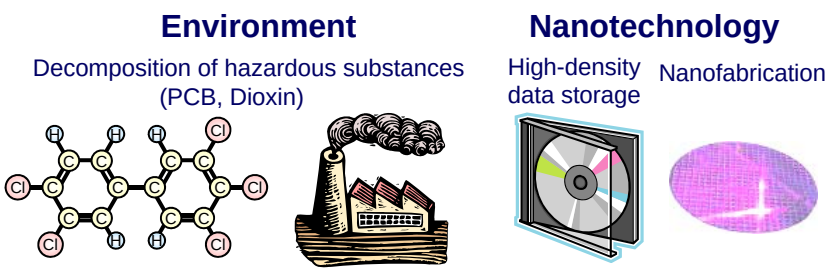

Fig. 2. Applications of AlN light-emitting devices

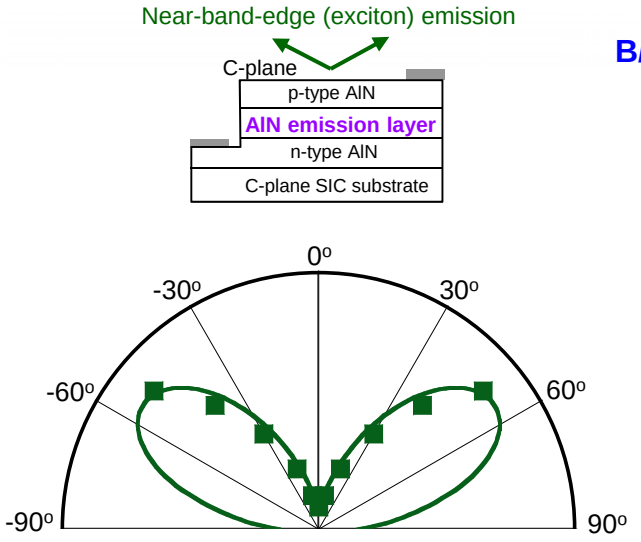

Fig. 3. Polarized near-band-edge emission from AlN LED

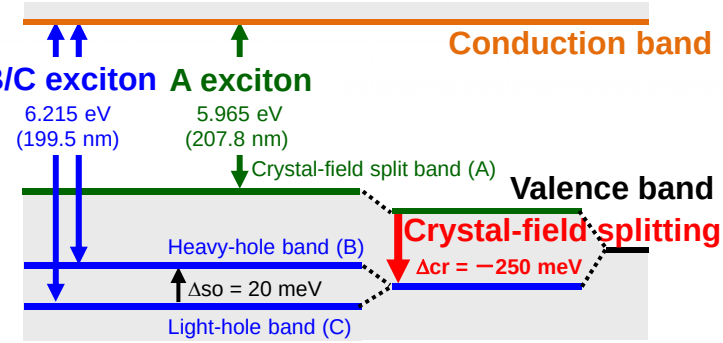

Fig. 4. Band structure of AlN

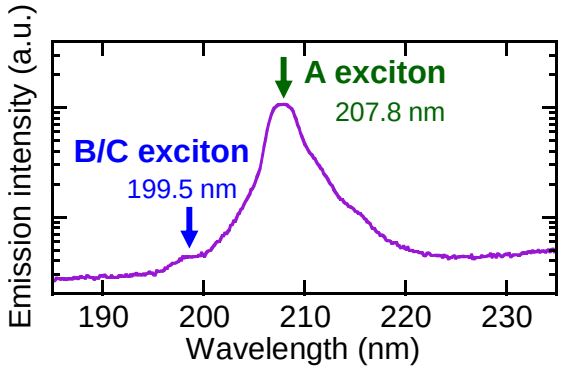

Fig. 5. Emission spectrum of AlN LED

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