

Supporting information

Boron nitride nanotube as a heat sinking and stress-relaxation layer for high performance light-emitting diode

Tae Hoon Seo^a, Gun Hee Lee^b, Ah Hyun Park^c, Hyunjin Cho^a, Jun-Hee Kim^a, S. Chandramohan^d, Seong-Ran Jeon^e, Se Gyu Jang^a, Myung Jong Kim^{a,*} and Eun-Kyung Suh^{b,*}

^aApplied Quantum Composites Research Center, Korea Institute of Science and Technology, Jeonbuk 55324, Republic of Korea.

^bSchool of semiconductor and Chemical Engineering, Semiconductor Physics Research Center, Chonbuk National University, Jeonju 54899, Republic of Korea

^cKorea Atomic Energy Research Institute, Jeonbuk 56212, Republic of Korea

^dDepartment of Physics and Nanotechnology, SRM University, Kattankulathur 603 203, Tamil Nadu, India

^eKorea Photonics Technology Institute (KOPTI), Gwangju 61007, Republic of Korea

† E-mail: myung@kist.re.re, eksuh@jbnu.ac.kr.

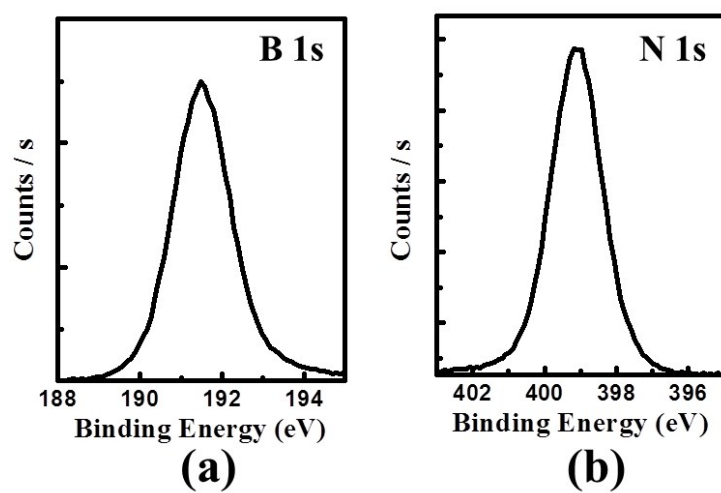


Figure S-1. X-ray photoelectron spectroscopy (XPS) spectra of B and N 1s core levels measured from the BNNTs.

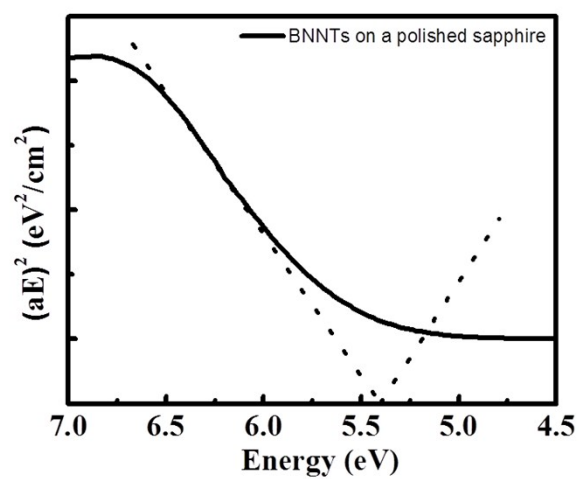


Figure S-2. Ultraviolet-visible absorption spectrum is taken to investigate the optical bandgap of the BNNTs. The band gap is estimated to be 5.4 eV.

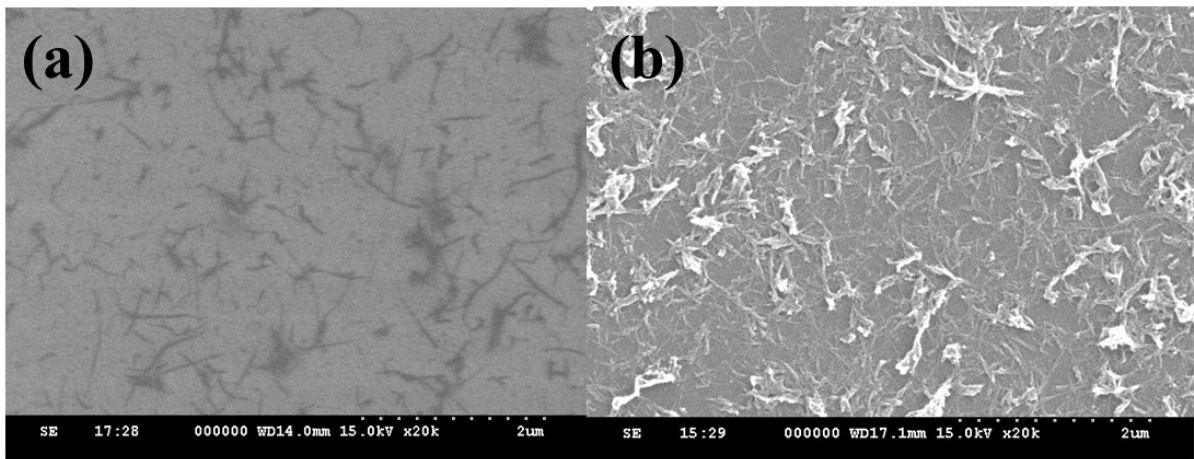
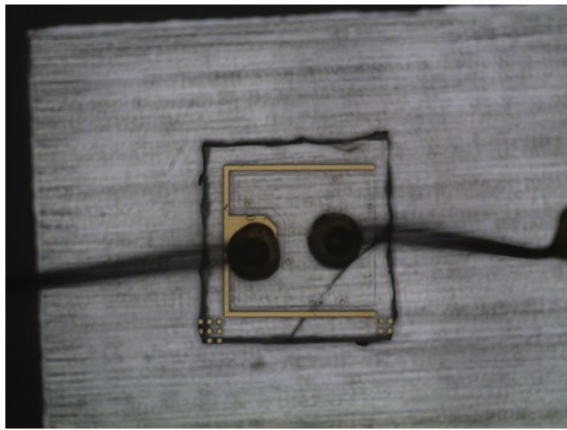
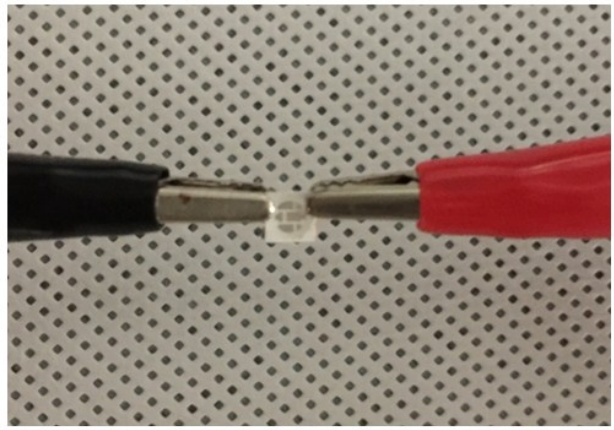


Figure S-3. SEM images of BNNTs formed by spin coating and spray coating methods on a sapphire substrate.



(a)



(b)

Figure S-4. (a) An optical image of a packaged LED chip. (b) A photograph of a packaged LED chip with an alligator clip for a current injection.

Collector

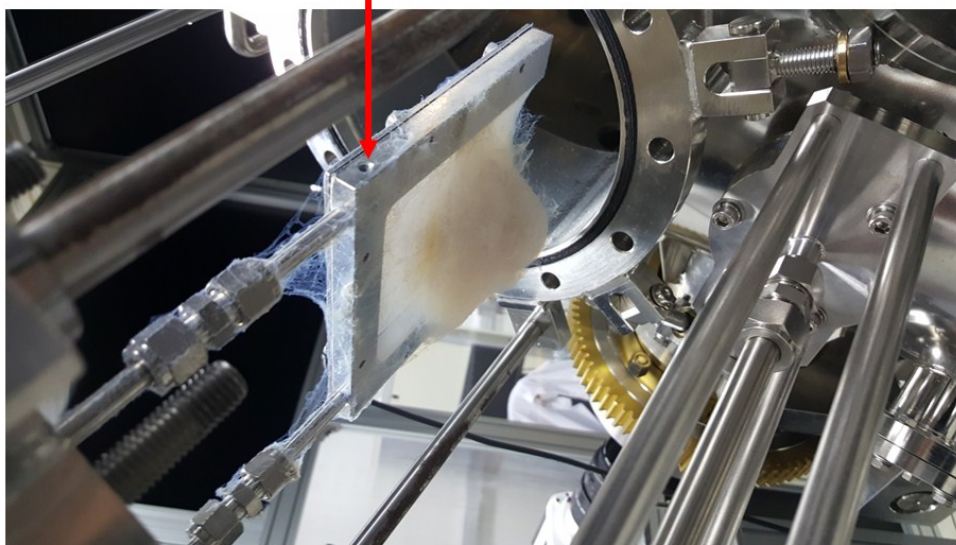


Figure S-5. (a) A photograph of BNNTs synthesized at the collector

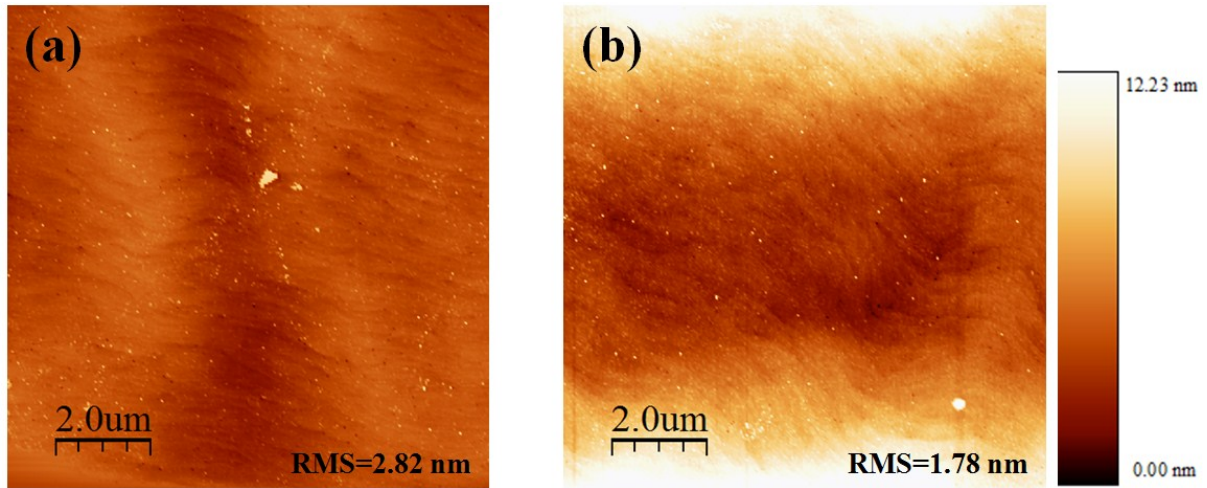


Figure S-6. (a) and (b) AFM images of GaN epilayers on SS and BSS for $10 \times 10 \mu\text{m}^2$, respectively