Docket #: S19-134

High performance, lower cost III-N devices via buried p-type epitaxial layer activation

Stanford researchers have developed a damage free method for activating buried p-type or Mg-doped epitaxial layers in III-nitride devices that improves performance and can reduce device cost when used as edge termination. Mg activation is challenging and limits GaN device design and development. The current method of dry etching to create holes to release hydrogen damages the buried Mg-doped layer, which negatively affects device performance. The proposed method uses ion implantation to gently create a conduit for hydrogen diffusion during post-implantation thermal treatment. During vertical III-nitride device fabrication, ion implantation can be used as edge termination, which reduces the cost of the device.

Figure

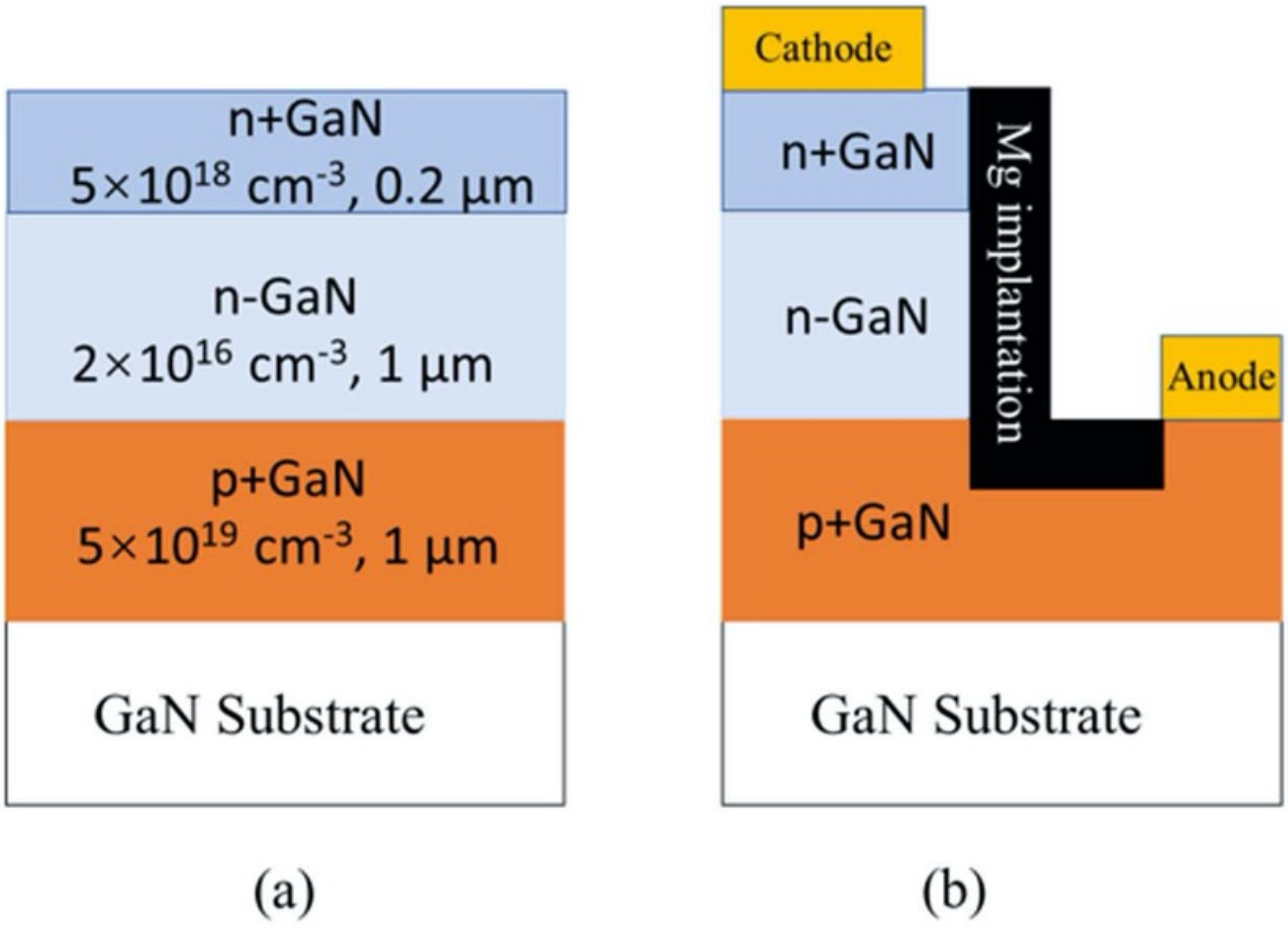

Figure 1 (a) avalanche photodiode/device, and (b) device, with a buried p-GaN layer and Mg-ion implanted edge termination.

Stage of development – Proof of concept
Researchers in the WBG-Lab successfully designed, fabricated, and tested a GaN p-i-n avalanche photodiode on a free-standing GaN substrate.

Applications

- Power electronics, RF electronics, and Optoelectronics using buried p-type III-N structures.
    - UV detectors, radiation detectors, position sensitive detectors for particle beams

    - Advanced light sources, and optical emitters (lasers and LEDs)

Advantages

- Improves device performance (reduces damage and defects in Mg- doped layer)
- Lowers cost of GaN devices

Publications

- Ji, Dong and Srabanti Chowdhury. "Devices including buried p-type Gallium Nitride layers and related systems and methods." US Patent Application 62/915,488, filed October 2019.

Patents

- Published Application: 20220230883

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