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Electrochemistry as a Disruptive Approach in GaN Technology

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Abstract

Electrochemistry, with the exception of metal deposition for contacting, is hardly represented in microelectronics, despite the many possibilities it offers, such as "soft" surface treatments (no surface bombardment, low damage), very sensitive methods (femtoampere sensitivity) and its great compatibility with high aspect ratio structures (TSV Cu filling). Today, "the more Moore's Law" is forcing researchers to look for alternatives to standard microelectronics processes in order to achieve breakthrough solutions: electrochemical processes can provide this new path. In this context, our presentation will focus on III-N materials, in particular GaN electrochemistry. The interface between GaN and the electrolyte semiconductor is detailed as a Schottky junction and the analogy between the physical and electrochemical concepts is highlighted". GaN electrochemistry represents a new approach to nanotechnology, both as i) a characterization method for optimizing microelectronic processes, and ii) a development method that opens up new possibilities. Examples will be presented: firstly, the original Mott-Schottky characterization method to optimize surface treatments during µLED and HEMT fabrication processes (Fig.1); secondly, the anodization of GaN to control optical and mechanical properties, in particular for photonic applications (µdisplay and Bragg mirrors Fig.2)). We will see how CV and CA (Fig.3) help to understand and tune the anodization process. The electrochemical approach brings a disruptive path and a new horizon to micro-nano fabrication.

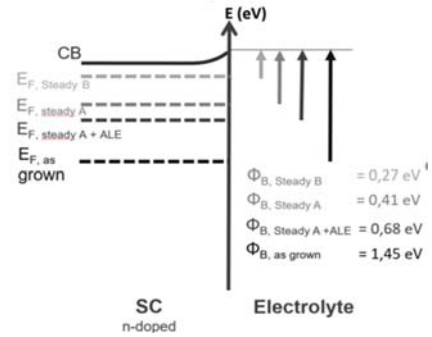

Fig.1: Barrier Heights determined with MS method (1) (2)

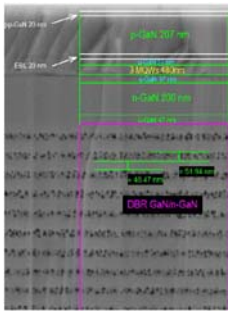

Fig.2: LED + Porous GaN DBR (4)

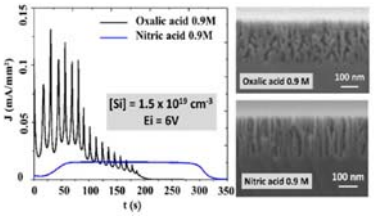

Fig.3: Chronoamperometry and resulting porous GaN structure (3)

References

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