

How to etch p-type GaN electrochemically?

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Considerable attention of the nitride community has been recently attracted by electrochemical etching (ECE) due to, e.g., possibility of refractive index tuning of GaN layers that can be implemented in distributed Bragg reflectors or lasers. [1, 2] Good understanding of ECE of n-type GaN and its high reproducibility makes this process a widely used technique. [3] Lack of a comprehensive model of the ECE of p-type GaN seemed to be an obstacle for the application of the controllable ECE process in p-type layers.

In this work we explain and compare the etching mechanism of p-type and n-type GaN using the band structure at the semiconductor / solution interface, see Fig. 1(a-b). We use a tunnel junction (TJ) to ensure a stable and controllable hole injection to the etched layer, see Fig 1(c). Porous layers were obtained in a narrow bias range. We discuss the etch rate and threshold etching voltage as a function of doping level and etching voltage. A comprehensive model of electrochemical etching of p-type GaN is shown for the first time. Presented experiments are in line with the proposed theory, thus we provide a way of controllable ECE of p-type GaN using TJ for efficient hole injection. [4]

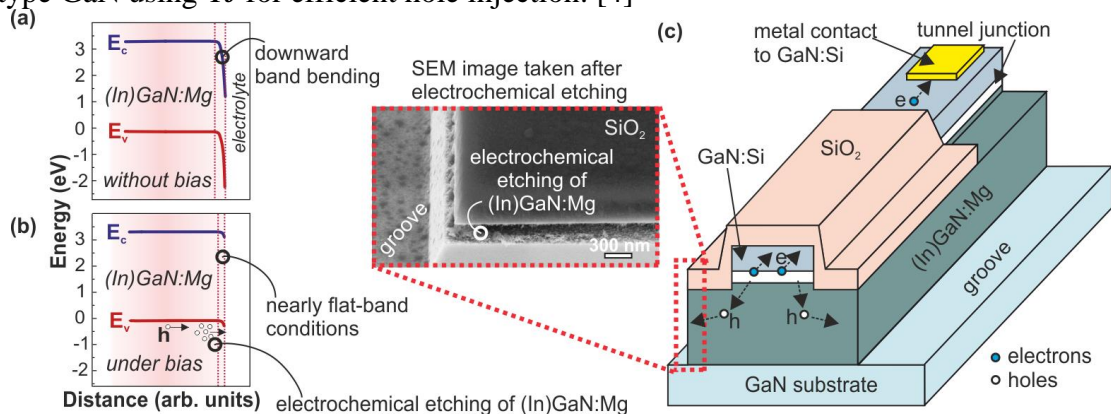


Figure 1 ECE of p-type (In)GaN: schematic band models of the semiconductor/electrolyte interface in equilibrium and under bias are shown in (a) and (b), respectively. Schematic illustration of the investigated structure is shown in (c) with an SEM image of the etched sample.

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