Quasi-ALE process for GaN: High etching rate without compromising the surface roughness.

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The atomic layer etching (ALE) process allows, theoretically, the selective atomic layer etching of the selected compound. In this work a Cl-based ALE process is developed to etch Ga-polar GaN (0001). Several parameters of the etching process are evaluated for assessing their influence on the ALE process namely, the ratio of the cycle devoted either to chlorination or Ar-sputtering and the applied RF power. The developed etching process, carried out at 5 mTorr, provides EPC values as high as 4 nm per cycle. Furthermore, because of the low-energy Ar plasma sputtering step, the etching process does not degrade the surface properties as reflected by the atomic force microscopy (AFM) and photoluminescence (PL) measurements without degrading the surface roughness [1]. Similar to other ALE processes reported in the literature, the smoothness of the surface is improved [2,3]. However, in comparison the EPC cycles in this work are larger-without any purge step within the cycle- thus reducing the time needed when the ALE process is applied during the nanofabrication process.

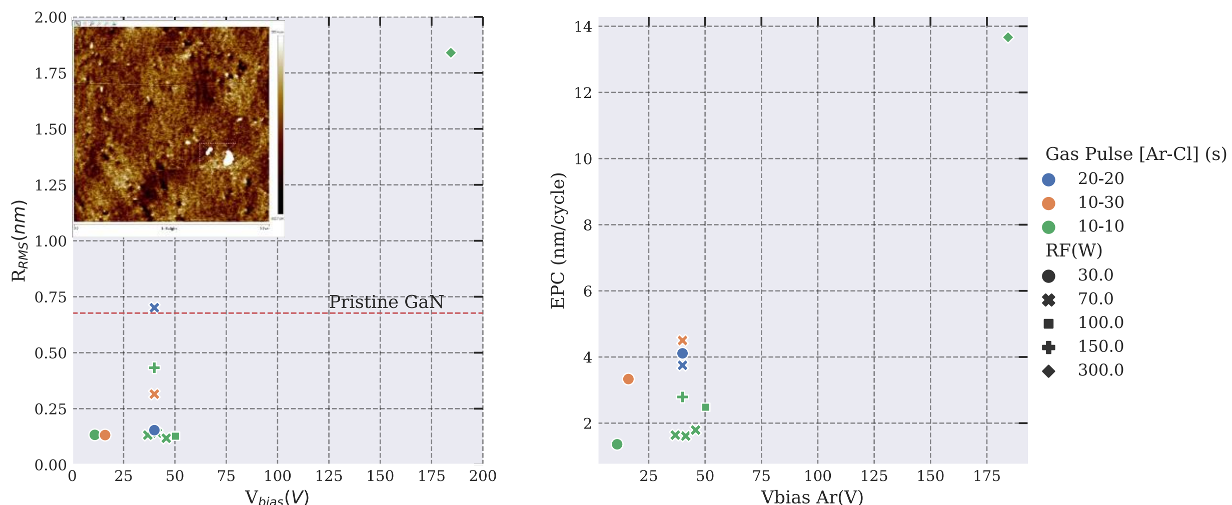

Figure 1 Left: Root mean square $R_{(RMS)}$ roughness values Inset:5x5 um AFM scan ($R_{(RMS)}$=0.224 nm) of a sample etched for 45 cycles with an Ar bias of 16 V and an EPC value of 3.3. Right: Etch per cycle (EPC) of the GaN etched films employing different conditions of the CL-based ALE process.

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