Sensors and Materials, Vol. 25, No. 3 (2013) 189–204
MYU Tokyo

S & M 0913

Surface Treatment for GaN Substrate —Comparison of Chemical Mechanical Polishing and Inductively Coupled Plasma Dry Etching—

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(Received August 6, 2012; accepted September 19, 2012)

Key words: GaN substrate, CMP, ICP dry etching, subsurface damage, plasma-induced damage

A direct comparison of surface treatment methods for GaN substrates, namely, chemical mechanical polishing (CMP) with a colloidal silica slurry and inductively coupled plasma (ICP) dry etching with $SiCl_4$ gas, is presented, and their advantages and disadvantages are summarized. The subsurface damage is evaluated from the intensity of the cathodoluminescence (CL) emission spectrum and by CL imaging. Although the CMP-finished GaN substrate exhibits a perfect surface free of scratches and subsurface damage, the removal rate achieved is insufficiently high. On the other hand, ICP dry etching is seen to be able to remove only subsurface damage with a remarkably high removal rate but not remove the scratches induced by the mechanical process. In addition, the introduction of plasma-induced damage during ICP dry etching is suggested. Clear evidence of the introduction of plasma-induced damage, which is a network of point defects originating from the mechanical effects of dry etching such as ion bombardment, is shown in this study by demonstrating the ICP dry etching for a CMP-finished GaN substrate and by discussing the reasons for the degradation in CL intensity. On the basis of the experimental results, the current issues to be solved for CMP as well as ICP dry etching are summarized toward the development of a suitable surface treatment for GaN substrate for III-nitride epitaxy.

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