PO1023

Silicon carbide surface micromachining using plasma ion etching of sacrificial layer

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The perfectly-defined patterning micrometric shapes by optical lithography and selective etch seems to be a crucial step for high voltage and MEMS device fabrication. Wet chemical etching, reactive ion etching and chemical-mechanical processing are widely applied in semiconductor industry to reach the surface shape. The processes are well known and successfully applied for photoresists or silicon oxide patterning.
The mechanical properties of silicon carbide such as high hardness and high chemical stability make the etch process more difficult in comparison with other substrate processing. The shape of etched junction termination extension for SiC devices often determines the breakdown voltage and reliability issues simultaneously. Furthermore, from the view point of total process cost, a simpler method of the refractory material pattering is preferable for the formation of the desired surface shape.
In the present research work new approach to the abovementioned challenge has been proposed and developed. We have demonstrated the shape transfer from the top sacrificial layer to bulk SiC material using Reactive Ion Etching (RIE) and Inductively Coupled Plasma (ICP) process. The work introduces the optimization hints to assure the etch selectivity ratio 1:1 for various materials. It appears clear that the optimized processes lead to satisfied selectivity ratio and make possible the transfer from sacrificial layer to bulk material. We have developed the ion etching of photo-benzocyclobutene-polymer resist (BCB) and silicon low temperature oxide (LTO) having roughly the same etch rate for both materials. Moreover, we have extended the etching process for silicon oxide and silicon carbide having roughly the same etch rate under the same conditions.

Keywords
silicon carbide
plasma ion etching
etch rate
shape transfer