Advanced SiC deep electrochemical etch in Hydrofluoric acid aqueous solution for the fabrication of thin suspended monocristalline SiC membrane.

G. D'Arrigo *, V. Raineri, S. Di Franco
CNR-IMM Stradale Primosole 50
95121 Catania, Italy

Abstract

The Silicon Carbide is the most promising material for the fabrication of a new category of sensors and devices, to be used in very hostile environments (height temperature, corrosive ambient, presence of radiation …). The fabrication of Silicon Carbide sensors requires new processes able to realise microstructures on bulk material or on the silicon carbide surface.

A very promising method to create microstructures in SiC is the electrochemical etch in aqueous solution of hydrofluoric acid. Here, are reported the characterisations of deep electrochemical etch obtained in a patterned structure, formed by standard material of silicon technology (silicon dioxide and polysilicon). Here are reported the characteristics of the etched structures, the etching parameters and the morphology characterisation of the structure obtained by microscopy analysis.

To etch the SiC samples was used an electrochemical cell with three-electrode with a SCE (Standard Calomelan Electrode) as reference electrode. The etching was monitored, with a Potentiostat Galvanostat model 283 of Princeptond Applied Research, measuring the current flow at the interface between SiC and the solution and the variation of the applied potential of the sample referred to the reference electrode.

The electrochemical dissolution of SiC requires the presence of holes during the etching as reported in the following chemistry equation :

$$SiC + 4H_2O + 8h^+ > SiO_2 + CO_2\uparrow + 8H^+$$

$$SiC + 4H_2O + 8h^+ > SiO + CO\uparrow + 4H^+$$

the formed Silicon Dioxide was dissolved by the presence of Hydrofluoric Acid:

$$SiO_2 + 6HF > 2H^+ + SiF_6^{2-} + 2H_2O$$

The formation of deep cavity in the patterned SiC substrate was monitored for different wafer having different dopants concentration and for various protective mask. The results obtained for the etching rate go from 0,12 μm /min to up 1.2-1.5 μm /min. The very promising results are used to create a suspended structures for the fabrication of a piezoresistive SiC pressure sensor for the control of the combustion in a fuel engine.

* Corresponding Author
e-mail: giuseppe.darrigo@imm.cnr.it