The Influence of Preparation Parameters on Structural and Optical Properties of n-Type Porous Silicon

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Introduction

The interest in macroporous silicon has increased greatly over the two last decades mainly due to its several potential applications as capacitors [1], membrane (pump of particles) [2], solar cell [3], Metallic barcodes [4]. etc. Macroporous silicon (MPS) can be fabricated withstraight pores and smooth pore walls by using back side illumination of n-type Si which is widely used in macropore formation on n-type silicon (n-Si) by photoelectrochemical anodization in aqueous HF containing electrolytes. Anodic oxidation of silicon is connected with the consumption [5] of holes at the surface. Holes can be generated by illumination. Howeverfew results are available on macropores formed underfront-side illumination. In this work, we describe the formation of macroporous silicon (MPS) formed on ntype Si (100) substrates at a constant current density under front side illumination using tow electrolytes. The first electrolyte consisted on HF/Ethanol used to prepare porous samples for 30min. The second electrolyte containing HF/Ethanol/H_2O_2 was used to prepare porous samples substrates for different etching time 10, 20 and 30 min.

Experimental Study

Macroporous silicon samples were obtained from n-type silicon (100) and resistivity (1-10 Ω.cm). The macroporous silicon samples were etched via electrochemical etching process in a Teflon cell using twoelectrolytes. The first electrolyte was composed to a mixture of HF/Ethanol to prepare porous samples for 30min. The second electrolyte was composed of HF/Ethanol/H_2O_2 used to prepare macroporous Si for different etching times (10, 20 and 30 min) at a constant current density under front side illumination so that to create more electron-hole pairs on the surface. After the etching process, macroporous samples were rinsed with ethanol and dried by nitrogen.

Results and Discussion

Effect of electrolyte

The SEM surface images of Si etched in HF/Ethanol/H_2O_2 (sample b), top view after etching under front side illumination for 30 min, shows that the poresize is larger than the sample etched without H_2O_2.

Effect of etching time

The results indicated that the pore density and the pore size of the macroporous silicon samples increased with the etching time. The infrared absorption spectrum (FTIR)has been carried out to verify that the freshly prepared MPS contains Si-H bonds. Finally, we found that theoxidant agent give a new

DOI: 10.21467/abstracts.122 ISBN: 978-81-954993-3-5

type of the macropores morphology, of which the shape of pores changes with theincreases of etching time.

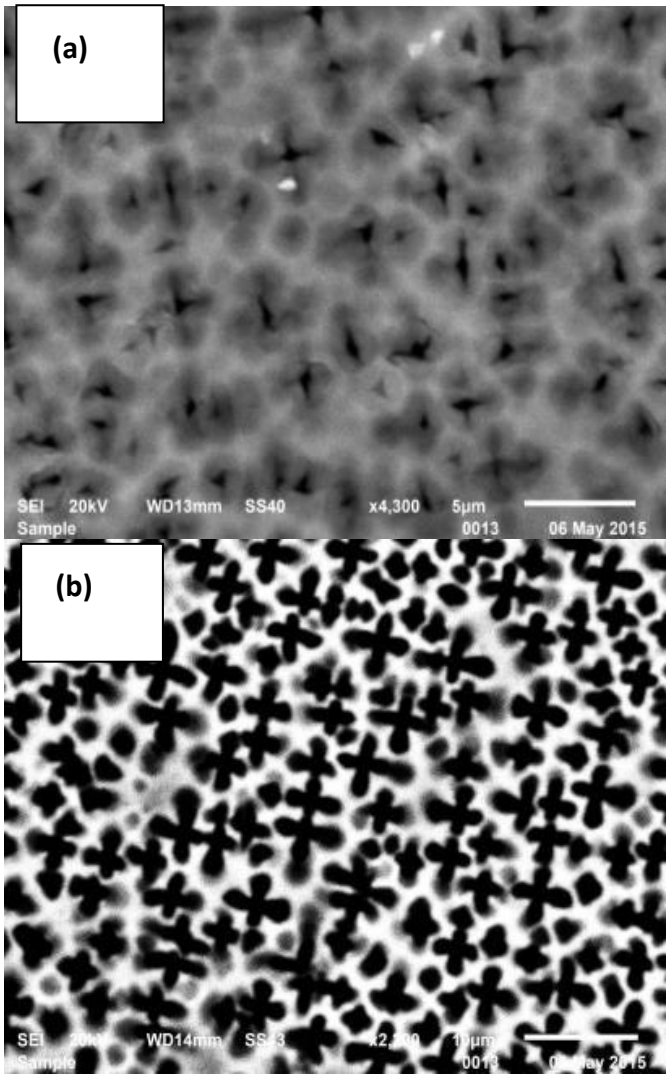

Fig.1: SEM images for MPS with etching time of 30 minfor different samples (a) without H_2O_2 (b) with H_2O_2.

Conclusion

This work was focused on the macropores formation in n-Si (100) using front-side illumination using two electrolytes the first without H_2O_2 and the second containing an oxidizing agent H_2O_2. It is found that the oxidant agent give a new type of the macropores morphology, of which the shape and the size of pores change with the increases of etching time.

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ISBN: 978-81-954993-3-5
DOI: 10.21467/abstracts.122
Series: AIJR Abstracts