

Conical structures by metal assisted chemical etching

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Pyramidal, conical or simply peaky structures could be found in a variety of applications, like in electroluminescence with field enhancement [1], and antireflecting surfaces [2]. Preparing such structures based on Si is a common practice, usually by chemical etching in KOH solutions. They are normally quadratic pyramids, with faces being $\{111\}$ planes, which are “etch stoppers” (the etching rate in directions perpendicular to those planes is of the slowest).

In the last decade, the Metal Assisted Chemical Etching (MACE) technique has been extensively studied and used for preparing different structures. It consists in the use metal particles, which catalyze the chemical reactions that remove Si at the positions where the particles are. The particles follow different directions inside Si, while etching takes place. The preferential etching direction is $\langle 100 \rangle$ deep into the semiconductor if the wafers are (100). However, some particles also move parallel to the surface, following the same directions.

We propose that it is possible to prepare conical structures taking advantage of the horizontal porosification besides the vertical one. The porous regions can be used as sacrificial material which can be dissolved. The proposed fabrication process consists of the following steps: Photolithography to define the sizes of the bases of the cones, deposition of Ag nanoparticles, MACE etching, thermal oxidation of porous Si, and dissolution of SiO_2 in HF solutions. Fig. 1 shows an example of the possible structures obtained by this method.

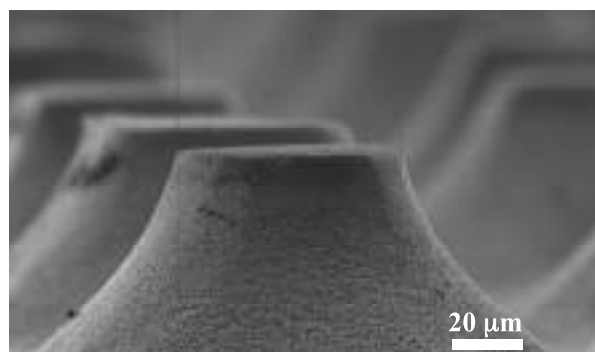


Fig. 1. Conical structure produced by MACE + thermal oxidation + chemical etching.

References

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