**Poster contribution**

## Sensor Chip Patterning: Advantages of Micro- and Nanopatterns by Means of Porous Silicon Technology

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The use of porous silicon for sensor fabrication has been studied during the last years. Due to its interesting properties, different kinds of applications are possible, i.e. interference filters for optical sensors [1], potentiometric biosensors [2], or capacitive microsensors for biological sensing [3]. Also, a porous microreference electrode was realized recently [3]. Another aim is to reduce the size of sensors using porous silicon microtechnology [4].

All these applications only used the two dimensional structure of the porous silicon layers, i.e. to enhance the sensitive area. But for some sensors, the third dimension could be useful to achieve new goals in the microchip and microlab development. In this contribution, the authors present a technique to prepare new three-dimensional porous silicon layers.

To prepare these layers, a new etching cell was designed. The result of an etching process carried out with a current density of 10 mA· cm² are craterlike compartments varying form 10 to 35 µm in diameter (Fig 1). The micropores that are visible at the walls of the compartments are in the range of up to 2 µm. It can be seen that the entire process is a statistic process, i.e. no masks have been applied to form the pores and compartments.

By varying the etching current, varying compartment sizes can be realized. The structure and the size of the compartments can be varied in a wide range from "normal", no compartment, porous silicon to compartments with a size of up to 35 µm. As an example, a sample etched with 4 mA· cm², only micropores with a diameter of about 2µm can be observed at the whole sample surface (Fig. 2).

The whole variety of possible structures is described in the model in Fig. 3.

These structures offer promising opportunities to be used in electrochemical microsystem technology [5]. With these structures it should be possible to move closer to the goal of a lab-on-chip product i.e. to register electrochemical processes in various bioelectrochemical environments. These compartments can be useful to be filled up with a sensing component (i.e., enzymes). One advantage of these compartments is the "reservoir" functionality combined with the adhesion improvement. The micropores at the walls of the compartments can enhance the adhesion of these components. Also, the adhesion of other surface coatings and membranes can be enhanced using these structures.. A further advantage of the entire process is the fact that the fabrication is a "one step" technology, since no masks have been applied to form these three-dimensional structures. Another advantage can be taken from the possibility to contact the sensor from both sides of the structures, front and back. That can be helpful to build up new sensor structures.

This process uses n-type silicon as base material. As Jeske et al. showed [6], p-type silicon can also be used as substrate for the formation of porous silicon layers to be filled up with sensing components. In upcoming experiments it is tried to adopt this process also to p-type silicon substrates.

References:

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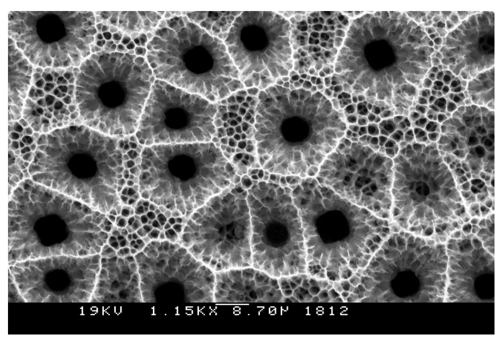


Fig 1: SEM micrograph of structures obtained after 10 mA· cm$^{-2}$ etching for 120 min and 1M KOH dip.

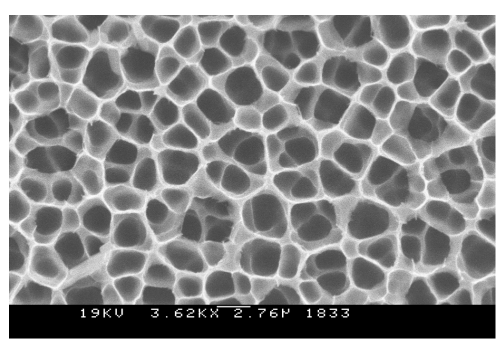


Fig 2: SEM micrograph of structures obtained after 4 mA· cm$^{-2}$ etching for 120 min and 1M KOH dip.

a b c d

a: i = 10 mA·cm$^{-2}$, b: i = 9 mA·cm$^{-2}$
c: i = 8 mA·cm$^{-2}$, d: i = 6 mA·cm$^{-2}$

Fig. 3: cross-section model of the resulting structures after etching with the mentioned current densities