Practice quiz anisotropic and isotropic wet etching of Si and applications

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Questions:

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1. Which one is a useful step for fabricating a thin Si membrane by wet etching starting from a monolithic Si substrate?

- ○ Instead of taking pure Si, take a wafer which is completely doped with boron at a concentration above 10^{14} atoms/cm^3
- ◉ Placing the Si wafer in a KOH anisotropic bath
- ○ Immersing the Si wafer in Piranha solution
- ○ Dipping before etching the wafer in a concentrated acetone solution

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Explanation

Anisotropic etching baths can be used for making very thin Si membranes of the order of 1 µm thickness. A single crystalline Si substrate is normally around 500 µm thickness. If we have a mask opening structure and put the Si wafer in a KOH bath, the etching stops at certain planes of the crystal, usually the (111) planes. If we proceed in time, the thickness of the Si substrate in the middle becomes always smaller, but it is impossible to stop this process exactly when there is only 1 µm left. One can implant boron in a very thin layer and, when the KOH etchant reaches the boron-implanted layer, the etching stops. This method that is used to structure micron-features into thick Si substrates is also named “bulk micromachining”. See "Anisotropic and isotropic wet etching of Si and applications" video 7:05 to 8:45 for detailed explanations.

2. In surface micro-machining, a thin Si membrane can be fabricated by removing a SiO_2 sacrificial layer beneath a Si functional layer. Which of the following is true for this process?

- ○ No access holes are needed on the polySi to remove the SiO_2 layer by wet etching
- ○ The SiO_2 layer can only be patterned by KOH etching
- ○ Wet etching of SiO_2 is performed by adding an electrical contact to the Si wafer
- ◉ A polySi layer is deposited in the form of a thin film on top of a patterned SiO_2 layer

✔

Explanation

Wet etching permits to make thin membranes by first depositing and patterning of a sacrificial layer like SiO_2. This patterning can be made by dry or wet etching. The next step is the deposition of a polySi layer on the patterned SiO_2 layer. It can be deposited by LPCVD for example. The final step in the process is the wet etching of SiO_2 in a HF bath forming fluorosilicic acid (H_2SiF_6). Access holes through the polySi layer are needed to remove the SiO_2 layer. This is an example of a “surface micromachining” process. See "Anisotropic and isotropic wet etching of Si and applications" video from 11:10 to 13:00 for detailed explanations.

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