Practice quiz etch stop techniques for thin membrane microfabrication and bulk micromachining

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Questions:

0 points possible (ungraded)

1. The etch stop by B implantation in Si, using B concentrations above 10^{20} atoms/cm^3, is a technique used to create thin membranes from Si wafers. What is a disadvantage of this process?

- ○ The technique requires the application of a positive potential to the wafer that produces holes at the Si/solution interface
- ◉ Very high B concentrations are not compatible with standard CMOS devices and they may compromise the crystal quality
- ○ The silicon crystal orientation has a high influence on the implantation profile and hence it creates its proper B distribution
- ○ The SiO_2 layer on top of the Si wafer does not provide a good B filtering and hence B implantation might extend more than the desired area

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Explanation

The main disadvantage of a B etch-stop is that we have to use very high B concentrations which are not compatible with standard CMOS or bipolar microelectronic devices and also that high B concentrations compromise the crystal quality. Therefore, sometimes an electrochemical etch stop is used as an alternative to make a thin membrane. See "Etch stop techniques for thin membrane microfabrication and bulk micromachining" video from 1:45 to 2:50 for detailed explanations.

2. What is the reason why a mask with arbitrary shape cannot be replicated accurately into the substrate by anisotropic wet etching of the bulk of the substrate?

- ○ A V-shaped structure appears under the mask because the etch rate in the (100) direction is slower than the etch rate in (111) direction
- ○ Using a mask with arbitrary curved structures results in different etching speeds, with deeper holes etched where the radius of curvature of the mask is higher
- ◉ Etching stops only when the etchant arrives at (111) planes, which ultimately results in an inverted-roof rectangular structure when viewed from the top
- ○ The opening that is etched underneath the mask is at an angle of 45° with respect to the mask itself

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Explanation

In KOH wet etching of an (100) wafer, (111) planes can be protected by a mask and the KOH cannot attack, via etching of other crystal planes, the Si atoms in a (111) plane. The final structure will result in an inverted-roof rectangular structure when viewed from top. See "Etch stop techniques for thin membrane microfabrication and bulk micromachining" video from 5:45 to 8:35 for detailed explanations.

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