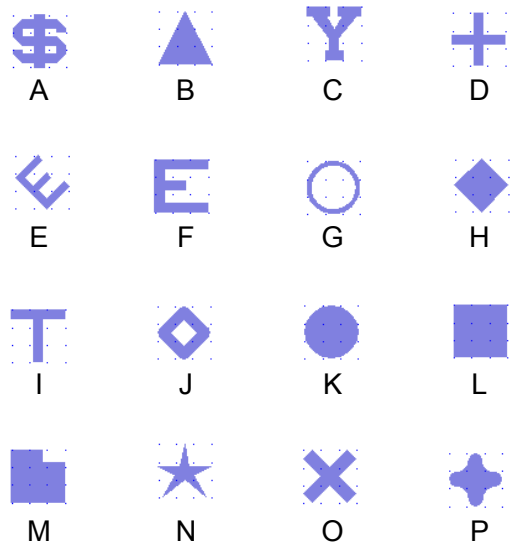
ECEn 550 – MEMS
Fabrication Lab
Week 2
"KOH Etching of Silicon"

Description

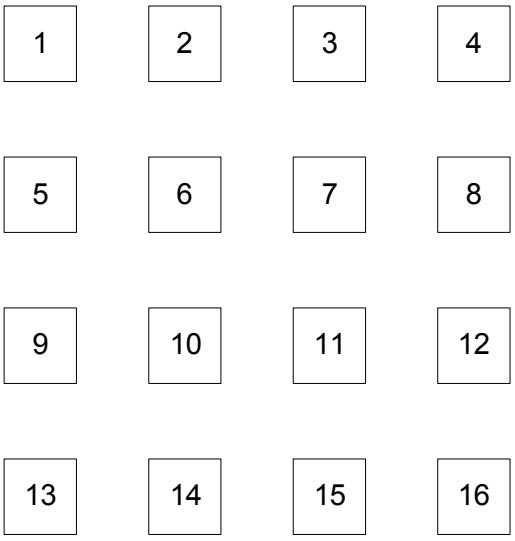
In this lab exercise you will learn to identify how initial mask shapes evolve during the anisotropic etching of silicon in KOH. Silicon wafers have been etched previously using a photomask containing **16** different two-dimensional shapes. Three different wafers were etched at three different times so that they have different etch depths. You will be given a map of the initial shapes and you will compare them to the etched shapes in the silicon wafers. The lab is over when you have correctly matched the initial shapes to those you see in the wafer.

Here is the catch: You will first be given the wafer that was etched deepest. As you know (or will very soon realize), shapes begin to look very similar once they have etched for a while in silicon. They all begin to resemble an inverted pyramid. You will be allowed to study the deepest etch pattern for a given time period using a microscope and attempt to match up the shapes. Report your "matches" to the TA. If you are not completely successful, you will be given the second deepest etch, and if not completely successful after that, the shallowest etch.

As stated above, the lab exercise is over as soon as the shapes have been correctly matched, or at the end of a two hour period. Write your match determinations in your lab notebook. Your grade on this lab will be based on the percentage of shapes you match correctly. The map of initial mask shapes is shown below on the left. You will identify the shapes etched into the silicon according to the numbering system shown on the right (the shapes originally had numbers next to them, but they became quickly unidentifiable after a few minutes of etching).



Map of original shapes on the left.



Numbering system for etched silicon shapes as they will appear on your silicon wafer pieces. The objective is to match the letters to the correct numbers (ie: A-7, B-11, etc.)

Major Objectives

1. Deepest Etch Depth. Obtain the deepest etch silicon sample from the lab T.A. This sample was etched in 30% KOH at 60°C for 2 hours. LPCVD grown silicon nitride was used as the etch mask and the patterns shown in the figure above were originally RIE etched into the nitride after photolithography patterning. You have 40 minutes to try to match the samples to the pattern. It is recommended that you use the microscope in the cleanroom attached to the **probe station**. Turn on the camera so that your entire group can see the sample at the same time. Any time you think you have matched the shapes correctly, you can ask the T.A. The T.A. can tell you which shapes you have matched correctly, but you can only ask twice during this time period. If you don't get very far with the matching, take the opportunity to admire the etched features and draw them in your lab notebooks.

2. Medium Etch Depth. If after 40 minutes with the deepest etch sample you have not determined the correct match, obtain the medium etch silicon sample from the lab T.A. This sample was etched in 30% KOH at 60°C for 1 hour. Again, you have 40 minutes to try to match the samples to the pattern. It is recommended that you use the microscope in the cleanroom attached to the **probe station**. Turn on the camera so that your entire group can see the sample at the same time. Any time you think you have matched the shapes correctly, you can ask the T.A. The T.A. can tell you which shapes you have matched correctly, but you can only ask twice during this time period. If you don't get very far with the matching, take the opportunity to admire the etched features and draw them in your lab notebooks. How did the etch shapes change?

3. Shallowest Etch Depth. If after 40 minutes with the medium depth etch sample you have not determined the correct match, obtain the shallowest etch silicon sample from the lab T.A. This sample was etched in 30% KOH at 60°C for 30 minutes. Again, you have 40 minutes to try to match the samples to the pattern. It is recommended that you use the microscope in the cleanroom attached to the **probe station**. Turn on the camera so that your entire group can see the sample at the same time. Any time you think you have matched the shapes correctly, you can ask the T.A. The T.A. can tell you which shapes you have matched correctly, but you can only ask twice during this time period. The lab is over after this 40 minute period even if you have not completely matched the shapes. Please turn in your notebooks with your best matches. Turn your etch samples back into the T.A.