

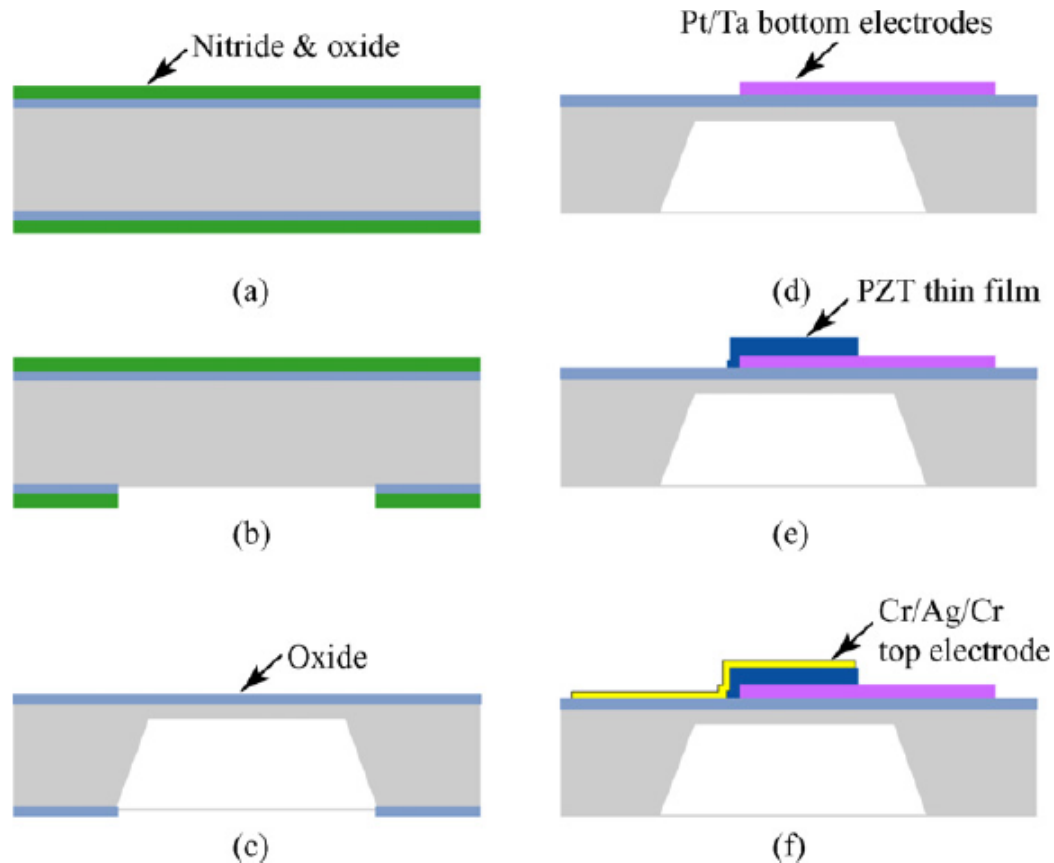
Home 5

Return by April 23th, 10 pm

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Q1a: Piezoelectric test device: 0.5p

Give more details to each step. Estimate dimensions and thicknesses.



Find out from literature what PZT is, how it is deposited and etched; no guessing.

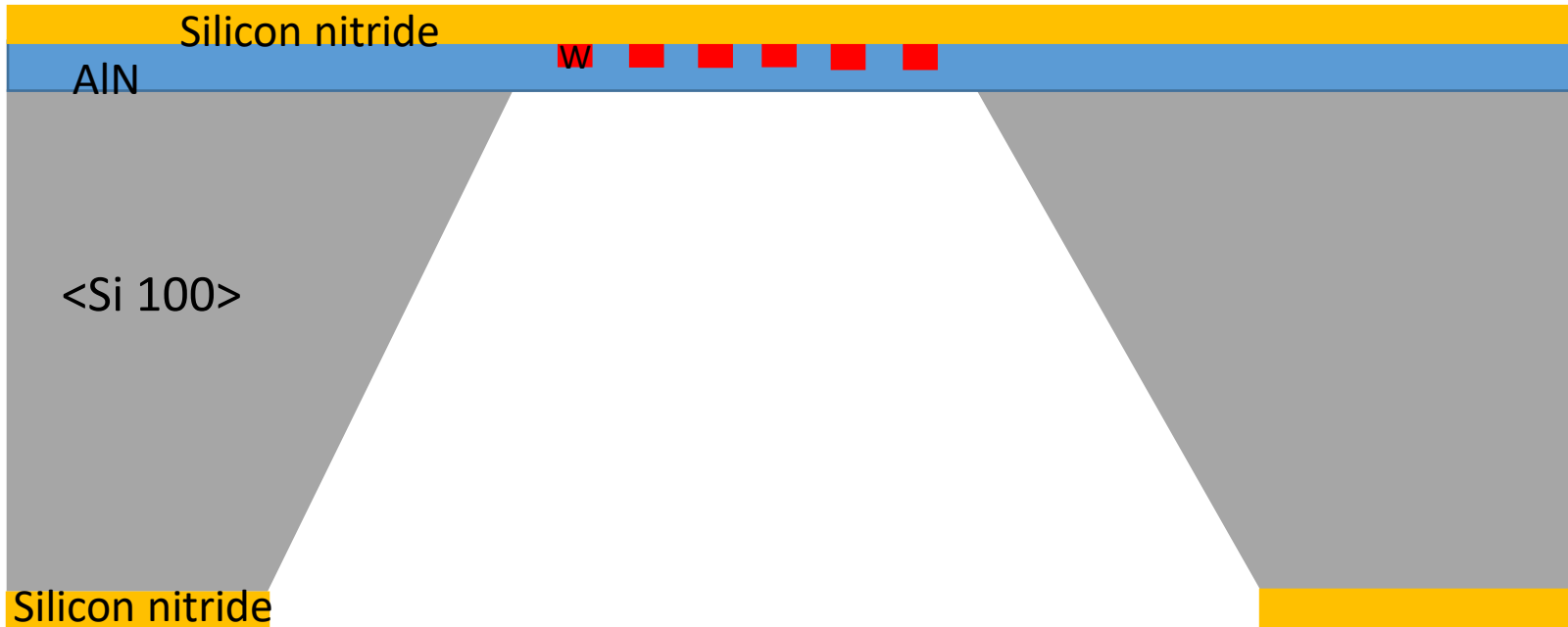
What is the role of Cr in Cr/Ag/Cr top electrode?

Note: Ta first, Pt then.

Q1b: Lamb wave resonator, 0.5p

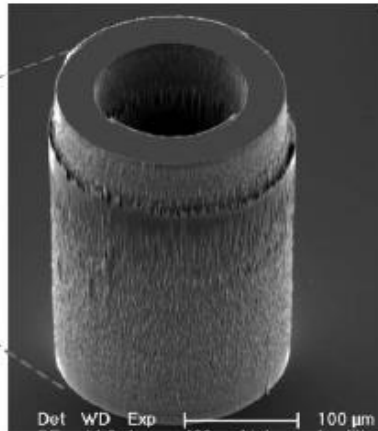
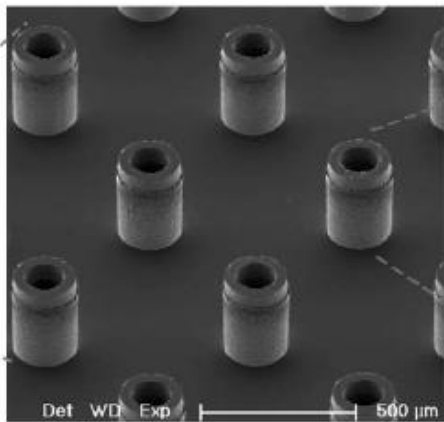
Explain step-by-step (in strict chronological order) the fabrication of this device.

Also give estimates of wafer thickness and layer thicknesses.



Q2: Thru-wafer DRIE'd nozzles, 1 p.

Explain step-by-step (in strict chronological order) the fabrication of this device.



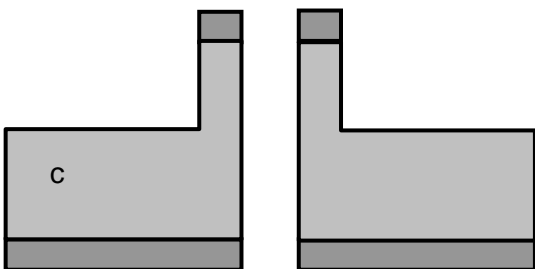
Dimensions (from SEM micrograph):

Nozzle:

outer diameter ca. 200 μm

Inner diameter ca. 100 μm

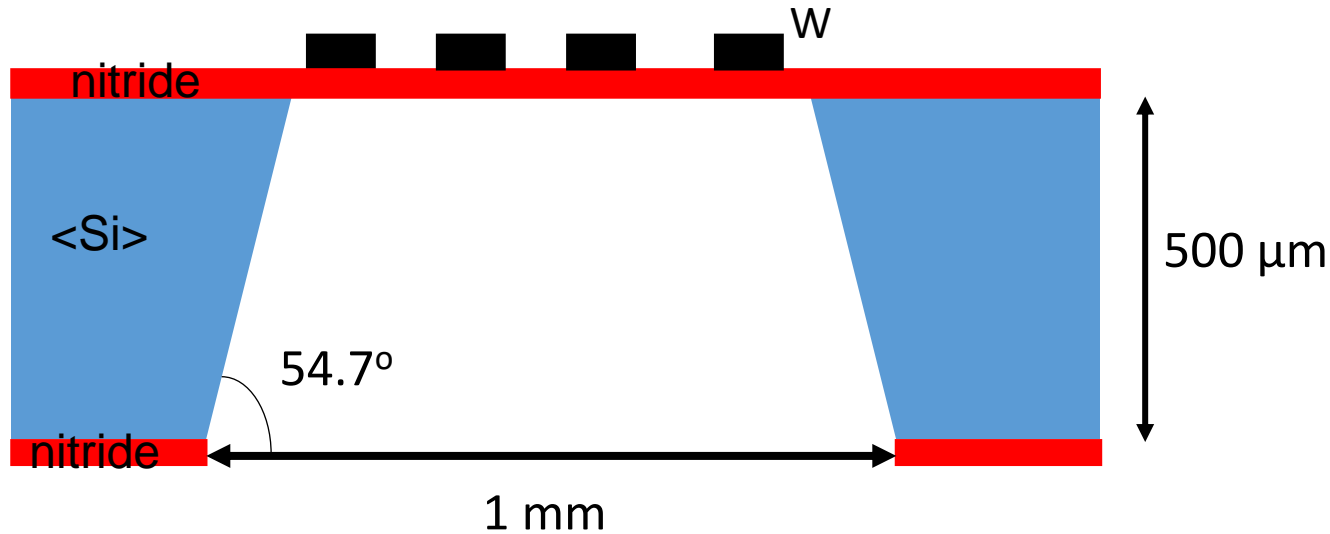
Height above surface ca. 200 μm



Things to consider:

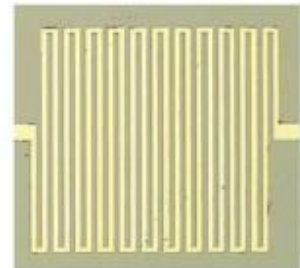
- mask material (hard mask needed !)
- alignment of top and bottom structures
- which side is etched first
- what aspect ratio that can be etched

Q3: Resistor on square membrane, 1 p.



Hint:

If your tungsten resistor litho + plus etch process can produce $5\ \mu\text{m}$ wide lines, and your W-sputtering process is capable of 20-500 nm thick films, what are the minimum and maximum values of resistors that fit on the membrane?



Q4: In-plane SOI microneedle, 1 p.

Explain step-by-step the fabrication process for 1 mm long in-plane microneedles for electrophysiology: the mechanical material is single crystalline silicon (orange); titanium (violet) is used as biocompatible electrode. Aluminum (black) contact pads allow contacting to outer world. Hatched material = CVD oxide. Add thicknesses for wafer and films.

