

Microfabrication

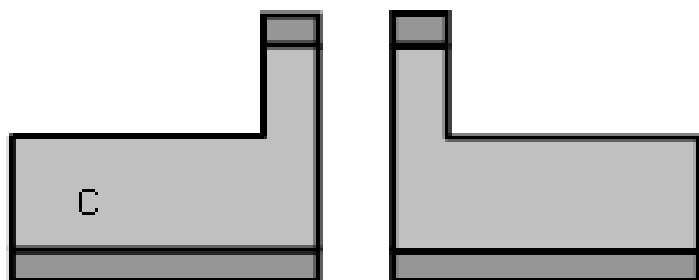
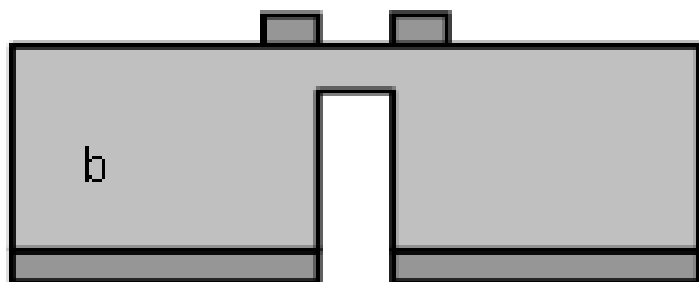
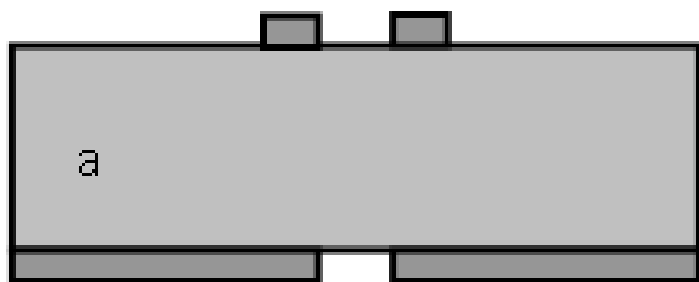
Home exercise #6:

MEMS basics

Return by March 23rd, 10 pm

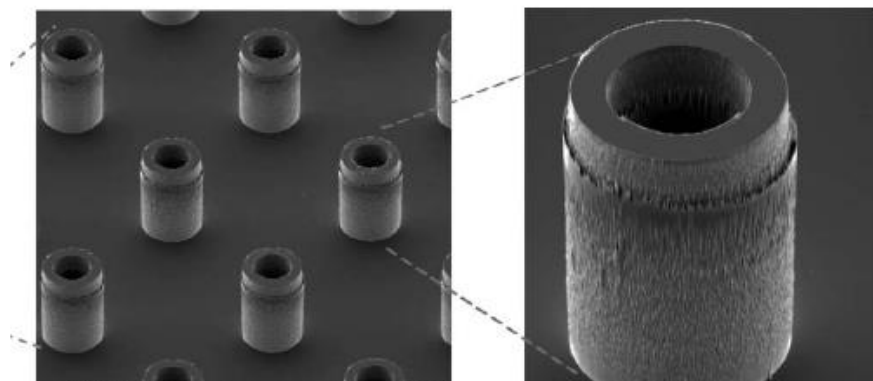
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1. Silicon nozzles by DRIE

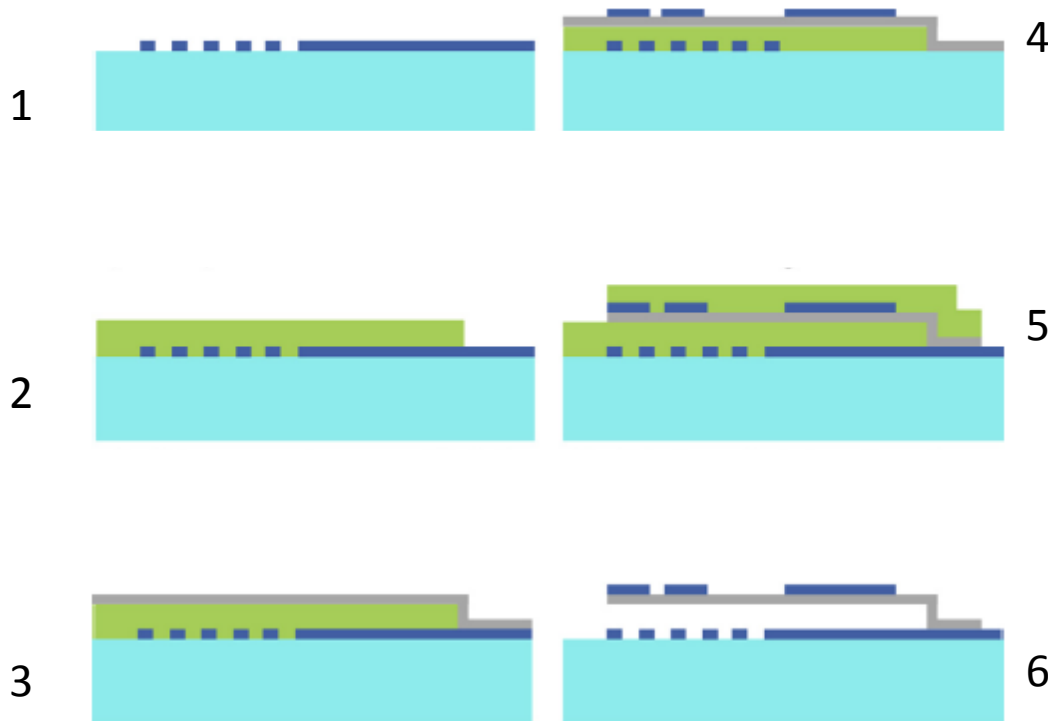


Explain step-by-step the fabrication of the nozzle array shown.

Identify materials, explain their deposition processes (e.g. 1 or 2-sided...), estimate dimensions (e.g. diameter etc.)



2. Thermal radiation sensor

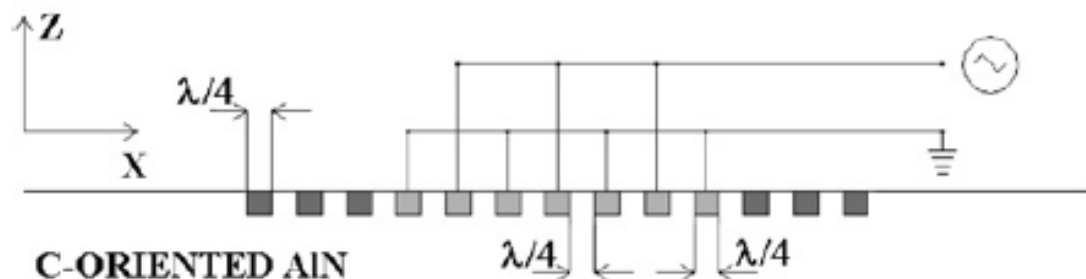


Explain step-by-step the fabrication process for the sensor shown.

Dark blue= metal, green=sacrificial material; gray= thermally insulating structural material.

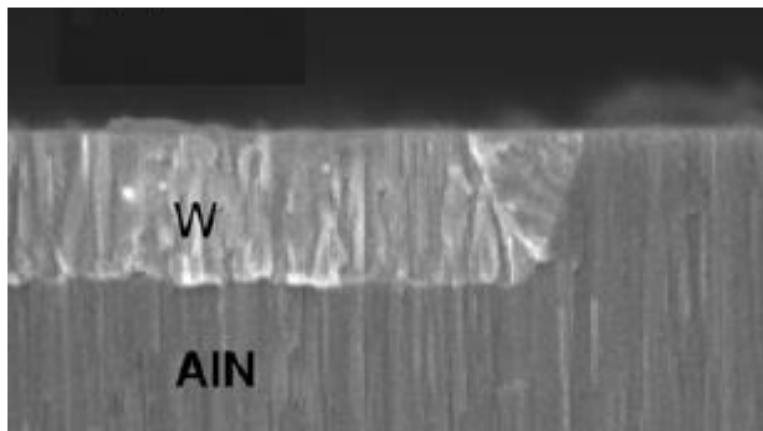
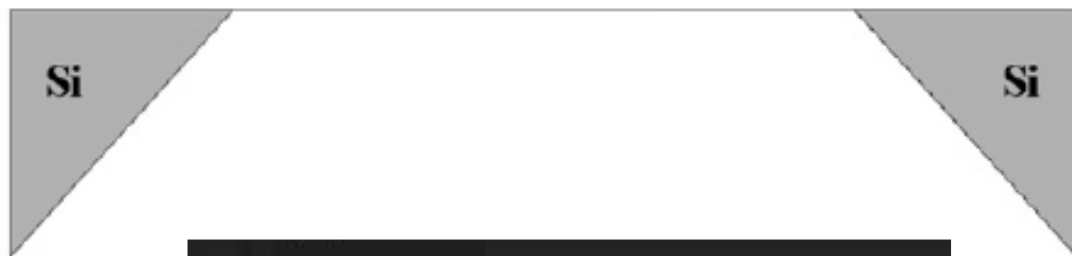
Propose real materials for these !

3. Lamb wave AIN resonator



Explain step-by-step the fabrication of this resonator.

The embedded $\lambda/4$ structures are tungsten, see SEM below.



4. Silicon etching

Nozzles are fabricated by etching through a 380 μm thick $\langle 100 \rangle$ silicon wafer by KOH. 540 μm wide nitride mask pattern is used.

a) Calculate the size of holes produced by an ideal process.

Then calculate the effect of the following real world uncertainties:

b) Wafer thickness variation 380 $\mu\text{m} \pm 5 \mu\text{m}$

c) $\langle 100 \rangle$: $\langle 111 \rangle$ crystal plane selectivity 33:1 vs. 30:1

d) mask width +1% narrower than the design value