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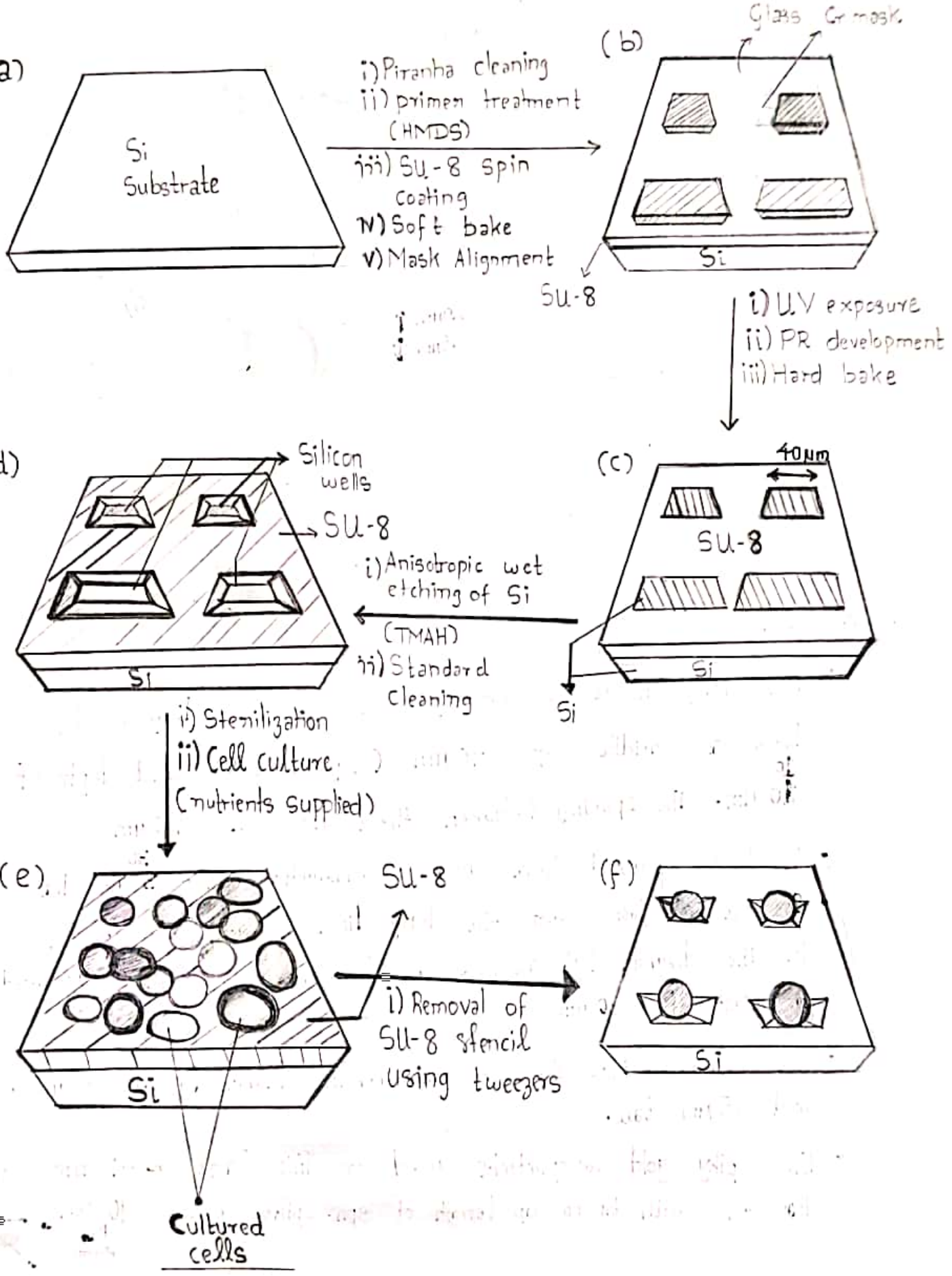
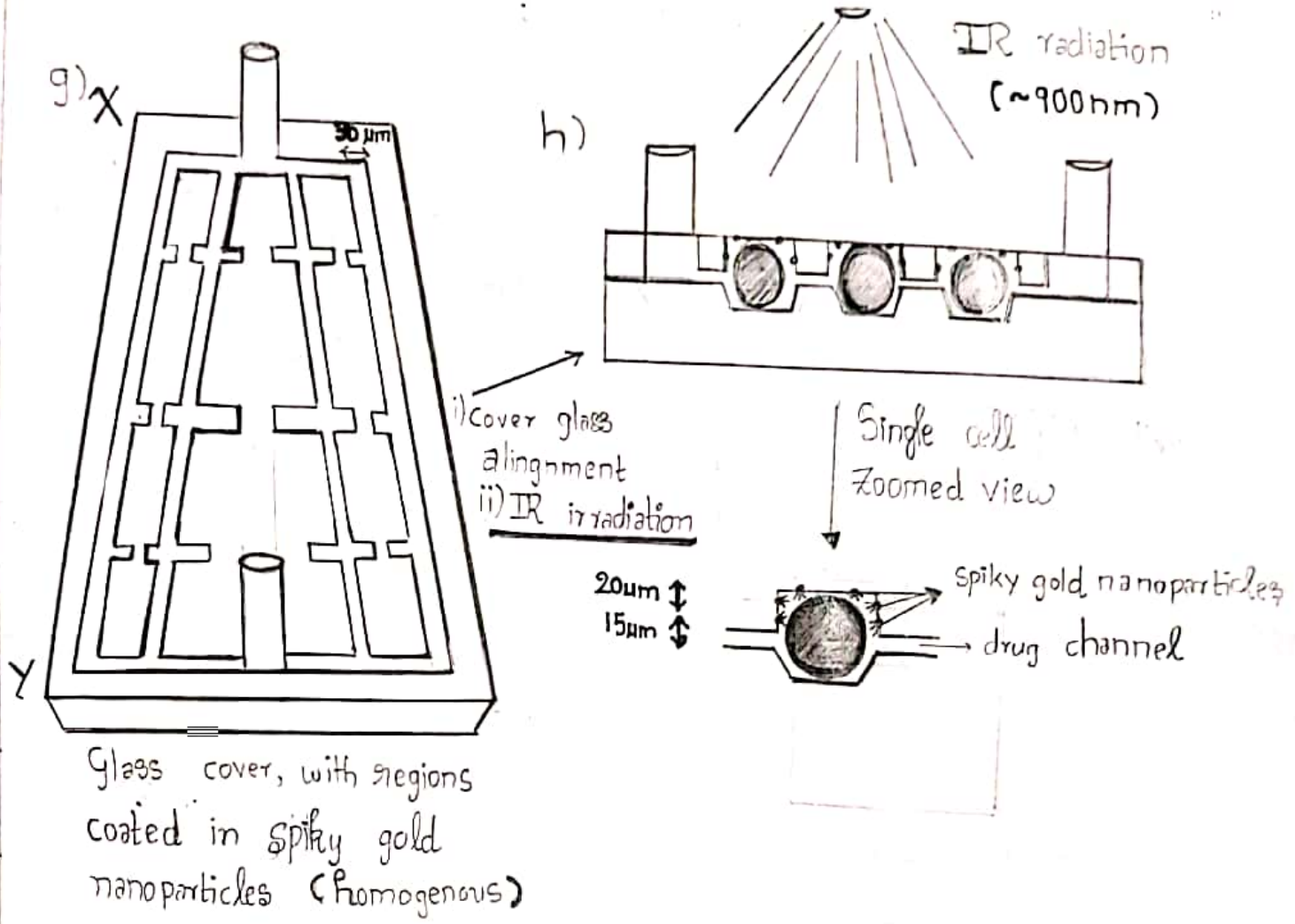
BE23B016

# ED5016 : Assignment - 4

## Fabrication process with device schematic :

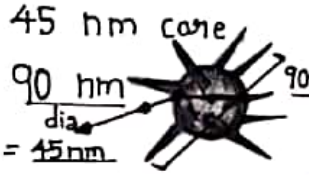
Piranha soln : 6:1:1 soln of $H_2O$, HCl, $H_2O_2$






Dimensions:

- The cavity made for trapping cells in the diagram (d), have a width of 40 µm (square hole) and depth of 10 µm. The spacing between these holes is 50 µm
- We have assumed here average eukaryotic cell ≅ 30 µm dia
- On the glass cover, the long lines running parallel XY in the diagram (g) all have a channel width of 30 µm and a height of 30 µm
- The channels into the cell chamber in diagram (g) are 30 µm wide and 15 µm tall.
- The spiky gold nanoparticles used in this are ~45 nm core diameter, with tip to tip length of spikes being 90 nm



## Working principle :

- In order to trap the cells, we have made a square hole on the SU-8 and etched about 10 μm into the Silicon.

- The small window and etch depth being less than the cell diameter ensures that the wells trap single cells on the removal of the stencil.

- Once we have the cell culture array, the desired drug is let into the inlet stream, and floods the extracellular region surrounding the cell.

- The glass coven also has been coated with spiky gold nanoparticles → These are immobilized onto the glass surface.

- Spiky gold nano-particles when irradiated with light of a particular wavelength (~ 900nm), give rise to a phenomenon called local surface plasmon resonance, in which the Electro-magnetic field strength is concentrated at the tip of the spiky nano-particles

- This concentration of the EM field at the tip leads to a local increase in heat which causes plasmon bubbles to form, the longer the laser pulse is active, larger the plasmon bubble. These lyse the cell wall, and if controlled properly, this small lysing of the cell wall at 2 or 3 spots is enough for the drug molecule to diffuse into the cell.

Expected results :

- This method offers temporal and spatial control during drug delivery, the size of the molecule to be diffused into the cell is not an issue, as pore size can be controlled by controlling source light intensity, or duration of pulsing.
- Viability is also not a major concern the safe-wavelength exposure range for cells is 630 - 1350 nm, which fits our requirement for the plasmon effect perfectly.
- Parallel processing also becomes trivial, with high throughput. The micro-array can be expanded to fit 1 million simultaneously in less than $100\,cm^2$.
- If a short time is required for drug delivery, pulse width or intensity can be modified accordingly
- If we want to determine the transfection efficiency of the chip, the following experiment can be performed

  → Once the cells are in place, PI dye can be flushed in via the inlet. The pulsing is switched on.

  → Once this is done, if taken to a fluorescence microscope the image can be captured.

  → This can be utilized to compute transfection rates, cell viability (%) and the intensity and pulse width can be adjusted appropriately for optimality of the chip.
- This device is also remarkably easy to use. It is also reusable, and can be used to carry out several tests.