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ELEC 4705 - Test 4

Nov. 30th 2018

Student Name:

Student Number:

1) (6 points) For an STM, explain what it is, what the acronym stands for, how it works, and what it is used for.

An STM is a scanning tunneling microscope. This works by having a nanotip brought very close to the surface of a material to be scanned and having tunnelling occur to that surface. the current is proportinal to the distance to the surface and thus allows for mapping of the topology of the material being analyzed. This is used as a microscope at sizes where a standard microscopy using light wouldn't work (because the features are smaller than the wavelength of visible light itself).

2) (4 points) What is the difference between anisotropic and isotropic etching? Give an example of a shape you could only make with anisotropic etching.

Isotropic etching has no directional dependance, whereas anisotropic is dependant on the crystal bonds and so has directional dependance and can form hard edges. This can be exploited to created shapes like an inverted trapezoidal trough.

3) (4 points) What is photoresist, how is it used, and what is the difference between positive and negative resist?

Photoresist is a chemical which reacts when exposed to UV light. It is used to create patterns for formation of microstructures underneath. Negative photoresist when exposed to UV light can't be washed away by the developper, whereas the positive resist is washed away when exposed to UV light.

4) (4 points) How could bacteriorhodopsin (bR) be used to create a state machine with write, read, and erase capabilities? What could this be used for?

bR can be moved into different states with different wavelength of light. This makes it that it could be "written" into a stable state using one wavelength λ_{01}, the read using another wavelegnth λ_{12} that excited the bR into a metastable state, then finally erased using a third wavelength λ_{10}. This can thus be used as optical memory.

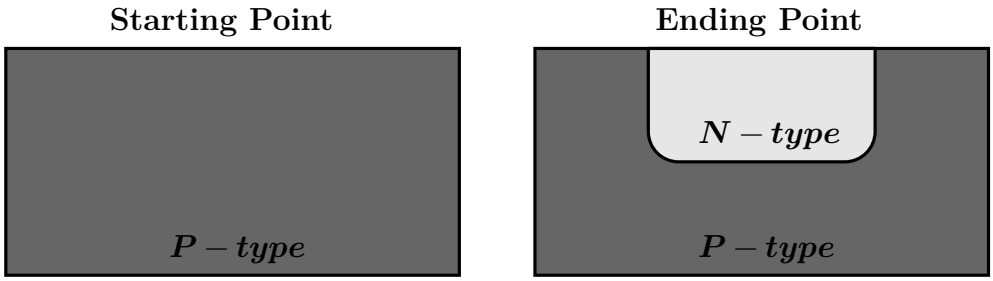

Figure 1 Starting and Ending Substrate

5) (12 points) An N doped well must be made in the center of a P doped substrate; with the aid of pictures and description, show the three steps (using the starting and ending points shown in Figure 1) that could be taken to produce this structure. Hint: Assume that any washing isn't a step on its own. Be as specific as possible about whats being done.

- The first step is to spin on photo-resist. In this case we'll use positive resist.
- the next step is to expose the resist the UV with an appropriate mask blocking the region to be doped, and then the unexposed resist washed away.
- finally the substrate can be doped and the remaining resist removed, leaving the structure described as the ending goal.