

2012 Qual Exam Questions

Prof. H.-S. Philip Wong

1. Consider an n-channel MOSFET designed for 1V operation with a metal to semiconductor source/drain contact (sometimes, this is called a Schottky barrier FET). Draw the band diagram in the direction normal to the Si/SiO₂ interface.
2. Next, draw the band diagram from the source to the drain assuming the nMOSFET is above the (small, positive, say 0.4V) threshold voltage and the drain voltage is small compared to the applied gate bias.
3. Now, if there is a gap between the edge of the gate and the source and drain metal to semiconductor junction, draw the band diagram again. Assume the gate dielectric extends across the ungated gap region.
4. If I now insert a dielectric layer on top of the gate dielectric. This gate dielectric has a dielectric constant of 20 and there are trapped positive charges between this 2nd gate dielectric and the original gate dielectric. Draw the band diagram again.
5. What does the band diagram look like if instead of isolated positive charges, there are electric dipoles (+ve on the 2nd gate dielectric side and -ve on the 1st gate dielectric side).
6. Sketch the I_d vs V_{gs} and I_d vs V_{ds} curves for case #4 and case 5 above.

The more questions you can answer, the more points you will get in the exam.