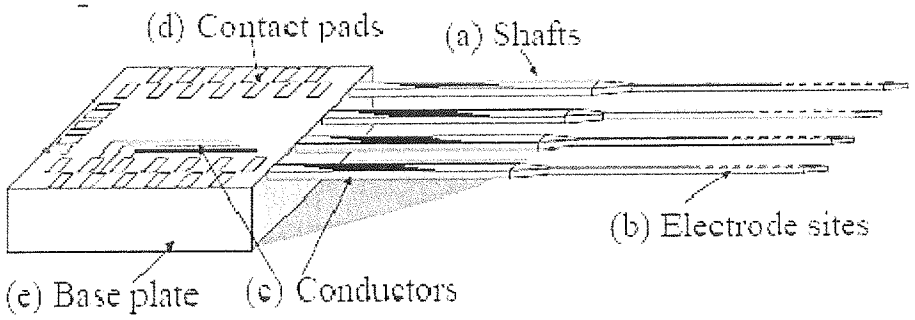
BE-2
August 2011 QE

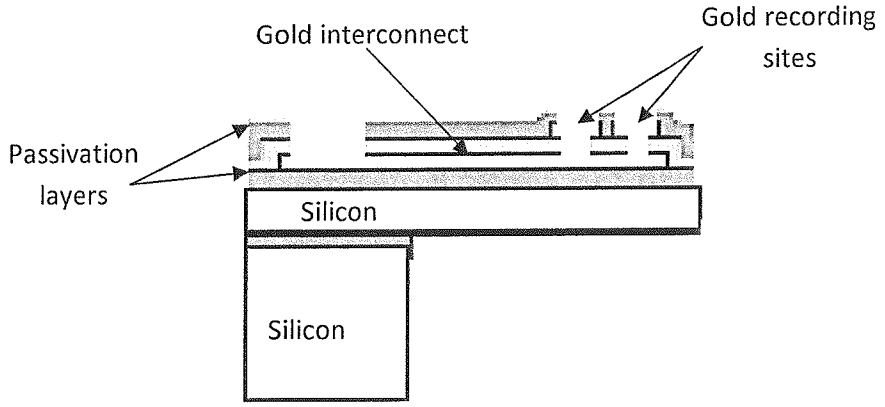
The following ten questions are qualitative and examine your basic knowledge of BioMEMS. They all have short answers. If needed, you can draw a schematic to explain your answers.

1) Name two chemical used for anisotropic etching of silicon. (5 points)
2) Stiction is a common problem encountered in releasing surface micromachined structures, name two methods to prevent stiction. (5 points)
3) What is SU8 and where it is used the most? (5 points)
4) Name two reasons why PDMS is a good substrate for microfluidics. (5 points)
5) Name two advantages of capacitive sensing over piezoresistive sensing. (5 points)
6) What is Reynold # and why it is important in microfluidics? (5 points)
7) What is electric double layer capacitance? (5 points)
8) Why do you need to remove silicon from underneath thermal sensors? (5 points)
9) Can you measure a physiological signal having a close to DC frequency response with a piezoelectric sensor? Explain your answer (5 points)
10) Commercial glucose sensors are electrochemical amperometric sensors. What do we mean by "electrochemical amperometric"? (5 points)

Write in Exam Book Only

A) The following figure show schematic and cross section of a silicon neural probe fabricated using bulk micromaching on an SOI (silicon on insulator) wafer. Draw the fabrication sequence used to fabricate such probes. Explain each step and count the total # of masks needed. (20 Points)





Write in Exam Book Only

B) A cantilever biosensor is designed to be actuated piezoelectrically using ZnO and its vibration to be detected optically using a lever system similar to atomic force microscopes (AFM). Draw a cross-section of the device and label all layers and components (15 Points)

C) Write down the force between two plates of a parallel plate capacitor connected to a battery in terms of voltage and geometrical parameters (A is the area of the capacitor and d is the gap. Assume the gap is air). Now assume that you scale all dimensions by a factor of s (e.g., if s=0.1 you reduce all linear dimensions by a factor of 10). How does the electrostatic force between the plates scale with s? Comment on scaling differences between electrostatic and magnetic force in the microdomain. (15 points)

Write in Exam Book Only