# Design and Analysis of Microcantilevers for Sensor Applications

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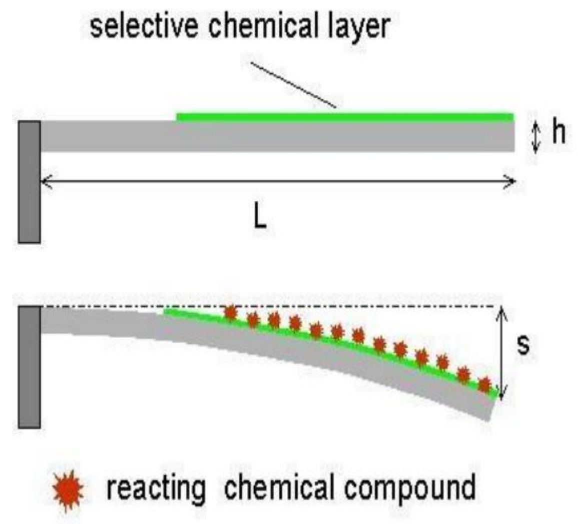
**INTRODUCTION:** A cantilever is type of beam which is supported and constrained at only one end and of course free at the other end. Since these cantilevers have their dimensions in micrometers therefore they are usually called as Microcantilevers. Micro cantilever is a widely used component in micro system devices. It finds wide range of applications in different fields such as biomedical, consumer products due to its flexibility and versatility.

In order to understand the behaviour of cantilever as a sensor it is required to know what are the processes taking place at the surface of the cantilever. As seen from the figure, firstly the cantilever surface is coated with a bio-receptor which binds only with the specific molecule in the sample. When the cantilever surface encounters the sample, the bio receptor molecules bind only to the specific molecule in sample. This results in increase in the weight over the cantilever which ultimately is a force in the downward direction due to the mass of the bonded molecule. As a result the cantilever deflects or bends and undergoes displacement at the free end. This amount of displacement is the factor which makes the cantilever to act as a sensor.

**DESIGN SPECIFICATION:** Models were designed and simulated using COMSOL tool.




**SOFTWARE REQUIRED:**

- COMSOL MULTIPHYSICS
- SIMULATION TOOL VERSION 4.2

**Figure 1**. structure of a Cantilever

## DIMENSIONS:

| S.No. | Shape of Cantilever | Displacement due to 8.036nN Force (um) | | |
|---|---|---|---|---|
| | | Silicon | SU8 Photoresist | Parylene |
| 1. | Rectangular | $7.0582*10^{-11}$ | $3.7251*10^{-9}$ | $4.1875*10^{-9}$ |
| 2. | Triangular | $2.3575*10^{-11}$ | $1.2437*10^{-9}$ | $1.4001*10^{-9}$ |
| 3. | Pi-Shaped | $7.4825*10^{-11}$ | $3.9613*10^{-9}$ | $4.4891*10^{-9}$ |
| 4. | T-Shaped | $7.746*10^{-11}$ | $4.0887*10^{-9}$ | $4.609*10^{-9}$ |

## SIMULATION RESULTS:

All the cantilevers are analyzed using the load of 8.036nN in Comsol tool. . Three different Shapes and four different materials were considered for the analysis of the sensitivity .

**Figure 2**: Simulation result obtained by using Rectagular shaped SU8 Plate

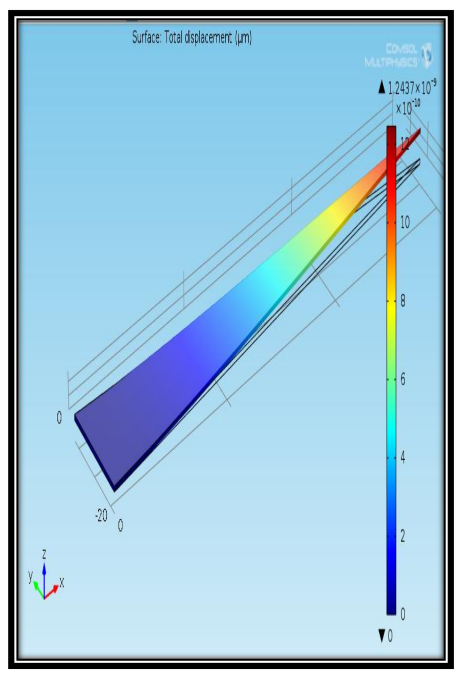


**Figure 3**: Simulation result obtained by using Triangular Shaped SU8 Plate

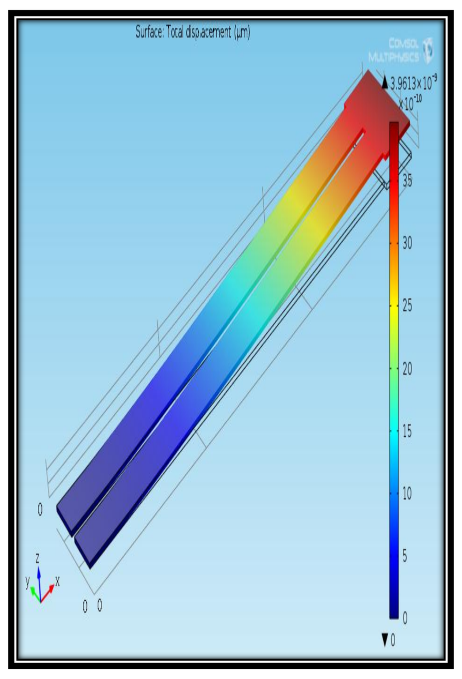


**Figure 4**: Simulation result obtained by using T Shaped SU8 Plate

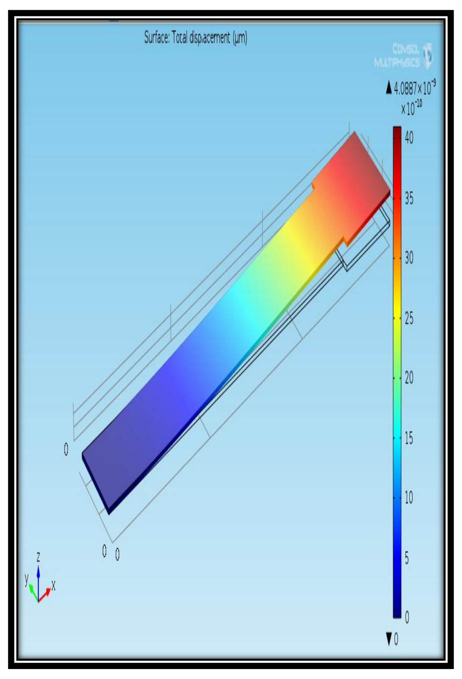


**Figure 5**: Simulation result obtained By using Tshaped SU8 Plate

## CONCLUSIONS:

We finally conclude that for mass sensitive cantilever to act as a bio-sensor for glucose monitoring application the best structure to choose is Parylene T-Shaped with the dimension as mentioned in the result. As we all know by now that the micro-cantilevers can be utilised as a bio-sensor but the future aspect of these cantilevers leads to the facts that they can be employed in variety of fields pertaining to industry, medical, defence etc. but keeping in mind the potential and drawbacks.

## REFERENCES:

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