

FEM Analysis Of MEMS Capacitive Pressure Sensor with Segmented Boss Structure For Diaphragm

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Introduction: MCPS is of great concern when meterology is scaling down to micrometers, The deflection in the diaphragm due to change in pressure produces a change in capacitance. The capacitance between two parallel electrodes can be expressed as,.

$$C = \frac{\epsilon_0 \epsilon_r A}{d}$$

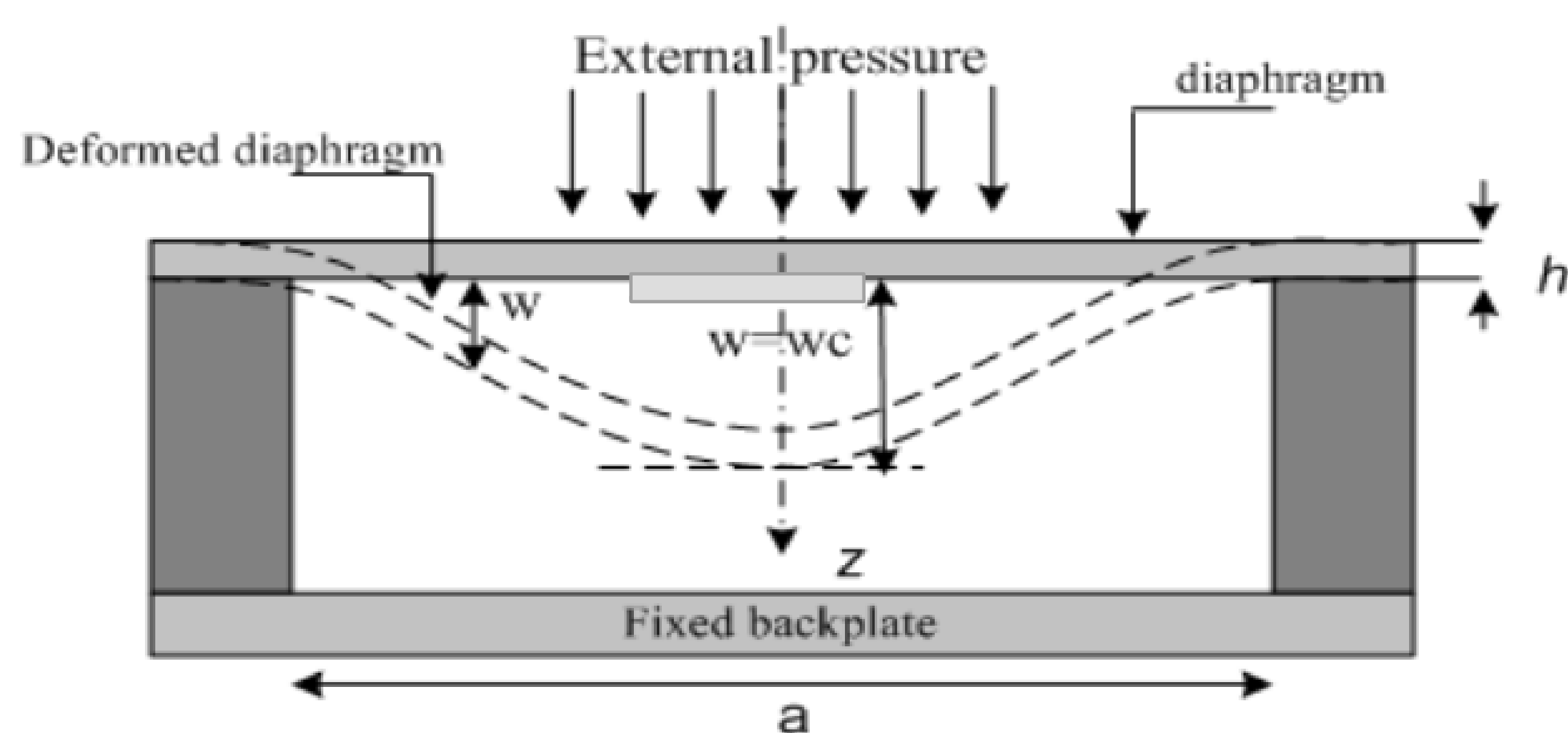


Figure 1. Diaphragm deformation with boss

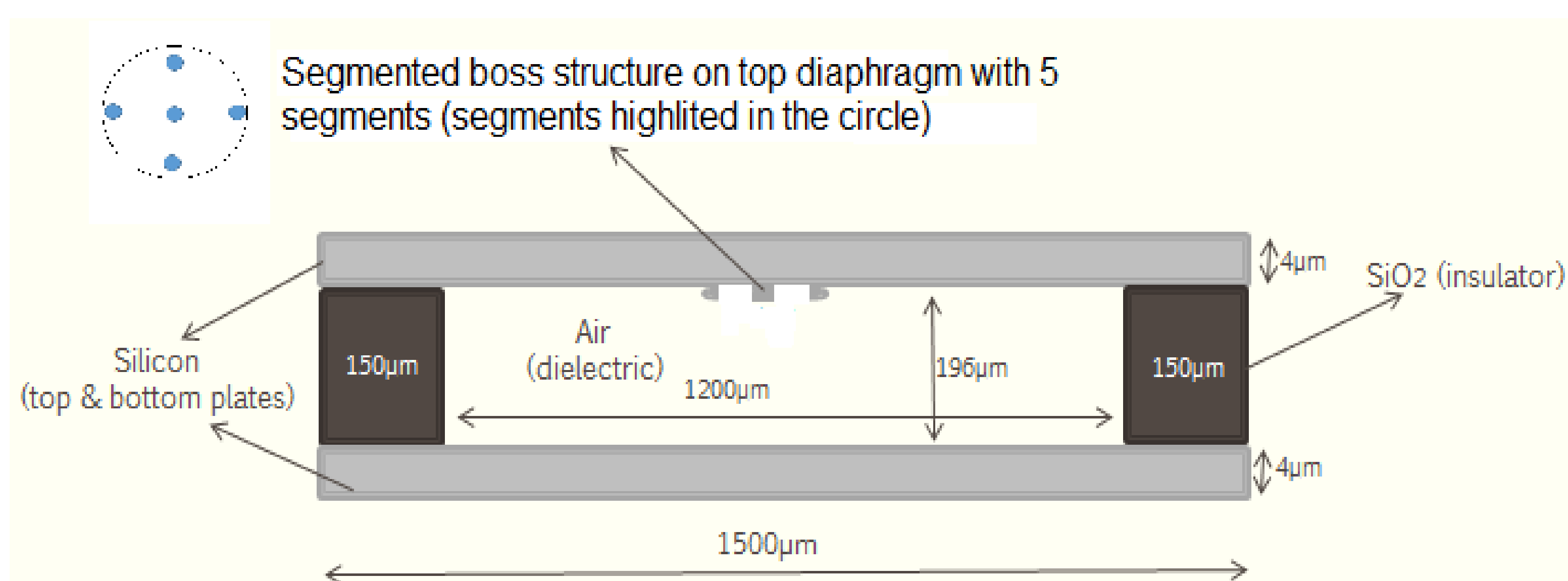


Figure 2. Diaphragm with segmented boss structure

Computational Method: .

The above equations describes the MCPS functioning physically, but for Finite element Analysis (FEA) the computation will be based on certain conditions that define the problem and it will be based on the equation.

$$\frac{\partial^4 w(x,y)}{\partial^4 x} + 2 \frac{\partial^4 w(x,y)}{\partial^2 x \partial^2 y} + \frac{\partial^4 w}{\partial^4 y} = \frac{P(x,y)}{D}$$

Where P(x,y) is the applied pressure and

$$D = \frac{Eh^3}{12(1-\nu^2)}$$

So the deflection w(x,y) is calculated by solving this PDE in all the nodes of the mesh.

Results: Figure 3 and 4 shows the FEM results of diaphragm with segmented boss structure and boss structure for the MEMS CPS diaphragm respectively. The graph plots diaphragm displacement against applied pressure.

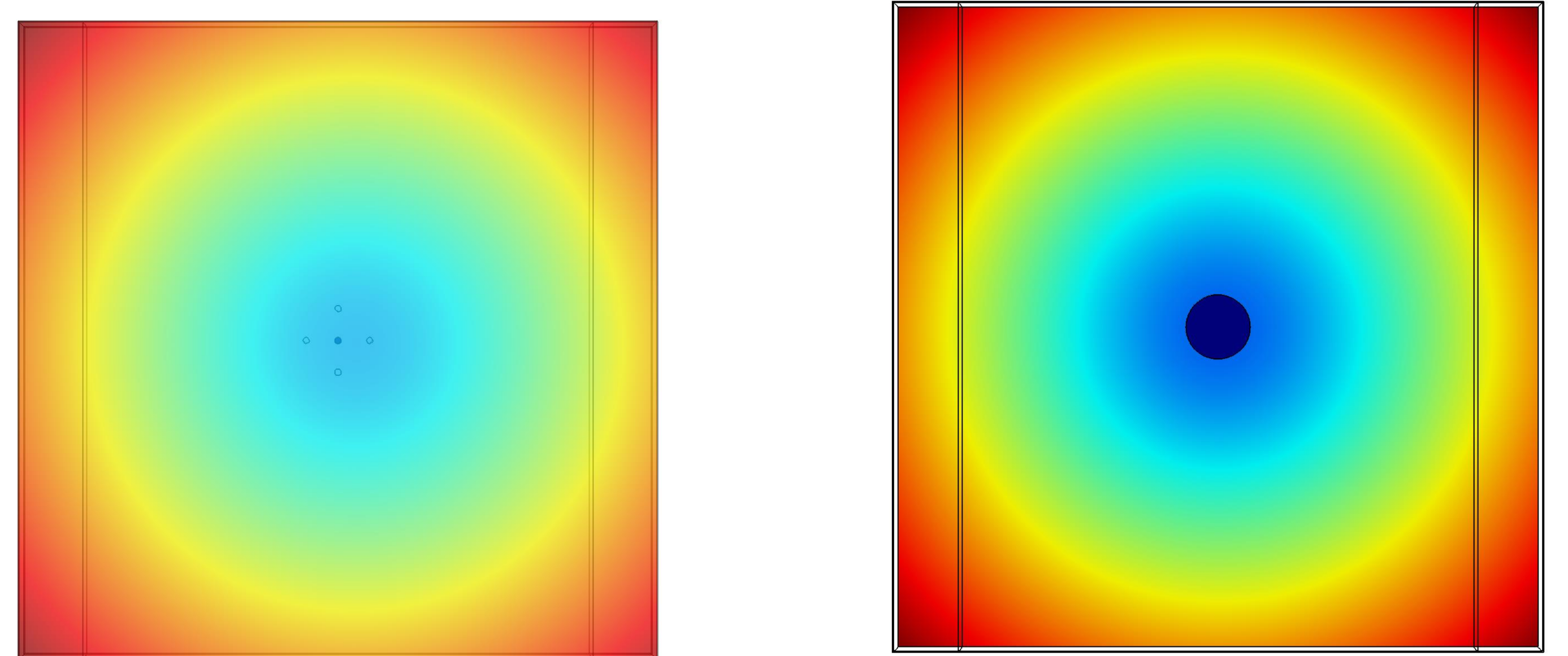


Figure 3. Title of the figure Figure 4. Title of the figure

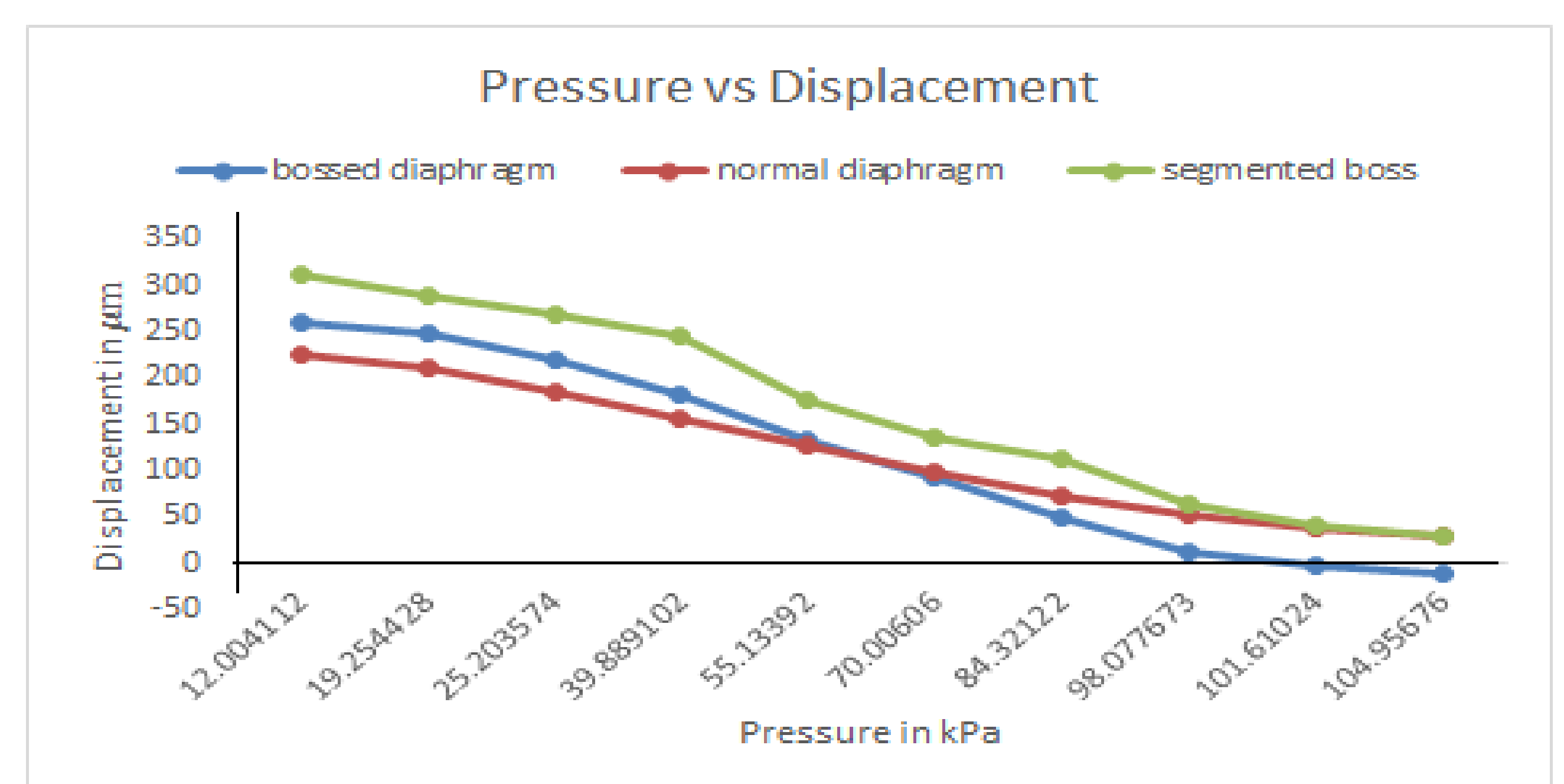


Figure 5. Graph showing the sensitivity and range

Conclusion: The FEM analysis found that the backpressure was reduced after segmentation of boss structure which can be used in applications with improved sensitivity and uncompromised range.

References:

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2. P. Eswaran, S. Malarvizhi,“Sensitivity analysis on mems capacitive differential pressure sensor with bossed diaphragm membrane,” in Devices, Circuits and Systems (ICDCS), 2012 International Conference on, pp. 704–707, IEEE, 2012