Simulation and Experimental Characterizations of a Thin Touch Mode Capacitive Pressure Sensor

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The **CADEMPO** project:

To provide low cost and disposable sensors to control in vitro cell cultures for therapeutic and toxicity tests.
Outline

- Introduction
- FEM model
- Modeling assumptions
- Simulation
- Validation process
- Conclusion
Introduction

- Capacitive-type pressure sensor
- Normal mode

How to linearize the C-P characteristics?

- Touch mode

Touch mode enables linearization of the C-P characteristics
FEM model

Capacitor configuration

Sensor geometry

Diaphragm is axisymmetric
Electrodes are symmetric
Modeling assumptions

Real system simplification

\[ C = \varepsilon \frac{A}{4} \]

\[ C = \varepsilon \frac{A}{16} \]

Equivalent model without dielectric

Modeling strategy

2D-axysymmetric model, 3D model coupled via the general extrusion operator
Simulation

- **Displacement [μm]**
  - Linear range: 9-40 kPa
  - $y = 1.467x - 30.241$
  - $R^2 = 0.9899$

- **Touched surface [mm²]**
  - Linear range: 9-40 kPa
  - $y = 0.39x - 2.6713$
  - $R^2 = 0.9934$

- **Load pressure [kPa]**
  - Small error of non-linearity
Validation process

Diaphragm deformation

Sensor response

Excellent matching with experimental data.

Excellent matching between physical system and simulation.
Conclusion

- A 3D multiphysics model has been developed for the pressure monitoring of a fluid in a channel.

- Geometry simplifications, symmetry and model coupling were successfully used to reduce the computational time.

- The model was validated through experimental data.
Thank you for your attention
Fabrication method

1. Substrate
2. Plate with etched pattern
3. Plaque support
4. Pad
5. Sealed ink cup
6. Ink