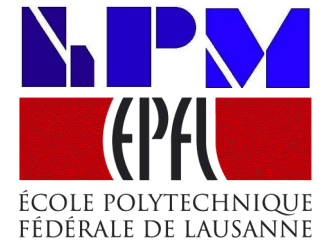


## Ultra-low flow sensor for neonatal resuscitator



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# Outline



- > Aim of the project
- > Specifications required for a neonatal resuscitator
- > Development of the flow sensor
- > Characterisation
- > Conclusion and outlook

# Respiratory assistance



- 10 Million newborns need resuscitation assistance each year
- 1 Million die from complication of birth asphyxia
- Neonatal chronic lung disease affects about 20% of infants who need respiratory assistance

## Neonatal Resuscitator

Airway pressure



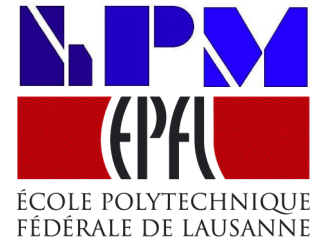
- Airway pressure
- Tidal volume
- Respiratory rate simultaneously



**Volutrauma**

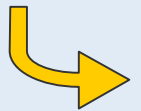
Minimizing risk of Volutrauma + Barotrauma

# New Neonatal resuscitator



Accurate measurement of

- the pressure
- the flow of air



Flow sensor based on the Venturi principle

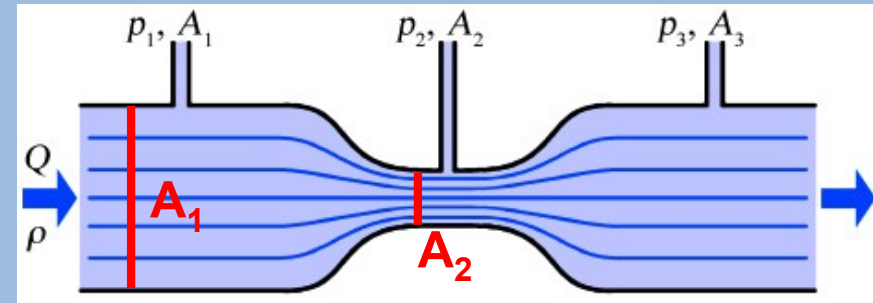


Specifications

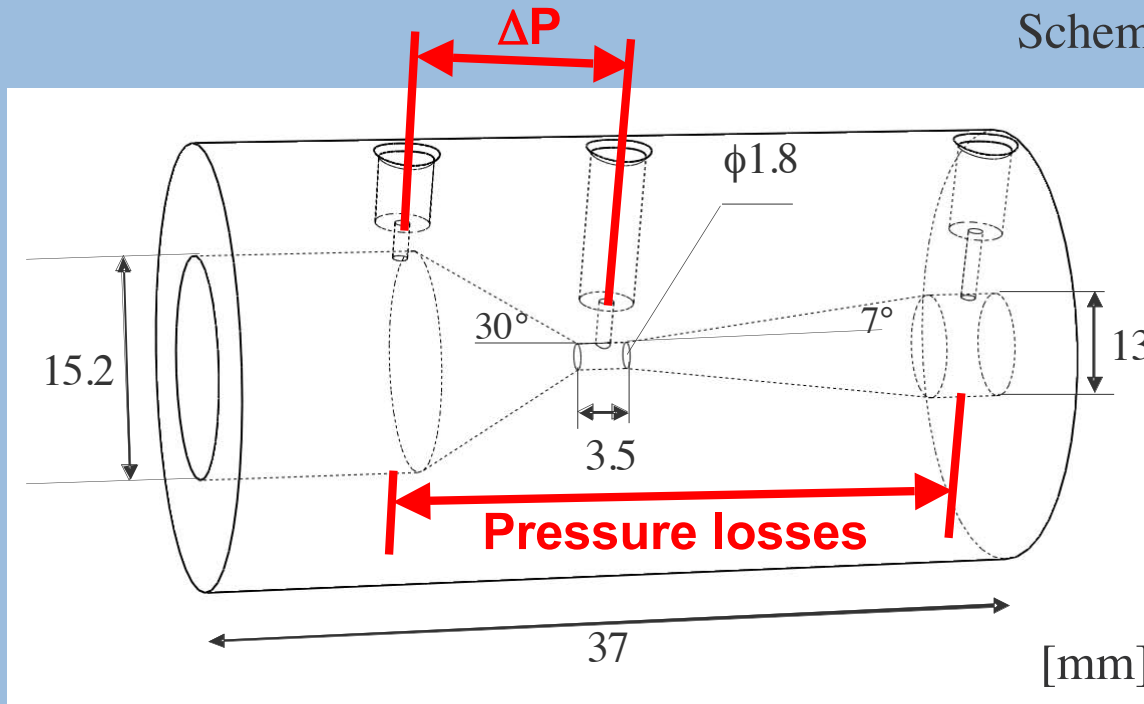
Flow sensor	1-4 ml/s
Differential Pressure sensor	$50 \pm 1$ Pa

# Venturi principle

$$A_1/A_2 \longrightarrow \Delta P$$

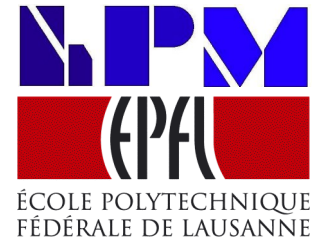


Schematic of a venturi tube

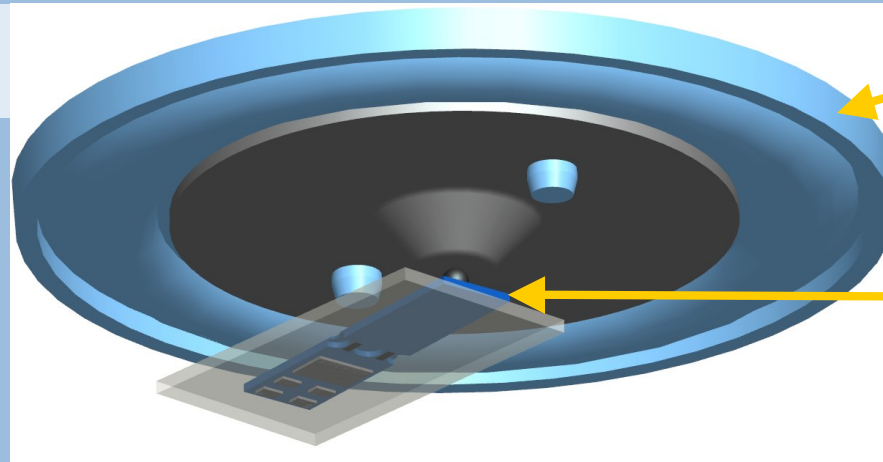


// Ultra low pressure sensor

# Differential Pressure Sensor



Pressure sensor



Membrane

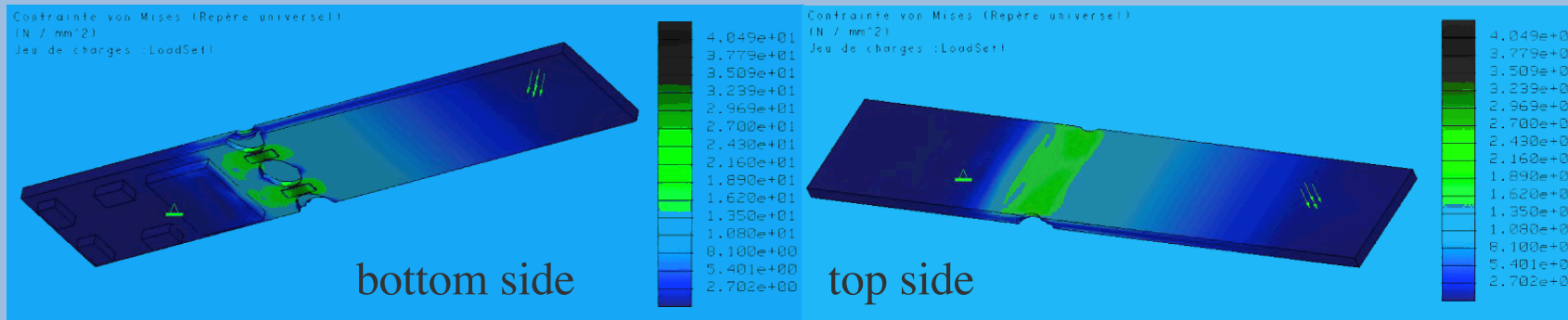
Cantilever

LTCC cantilever

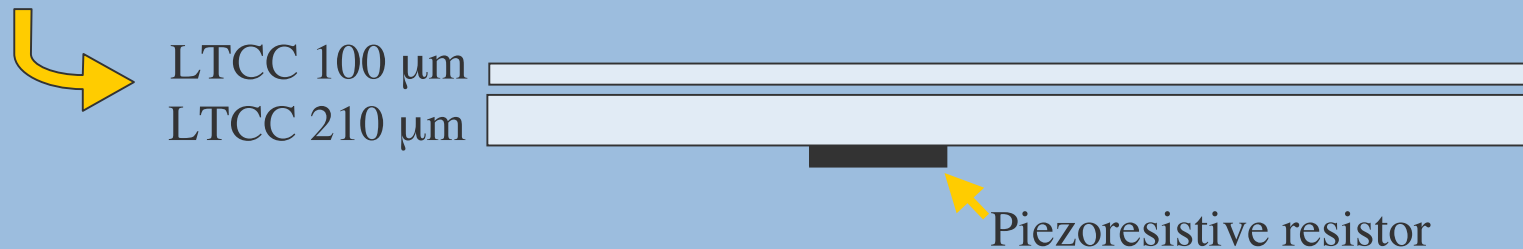
- Lower elastic modulus than  $\text{Al}_2\text{O}_3$
- Thin tapes
- High structurability

# Dimensioning of the sensor

Finite element modelling demonstrating concentration of compressive strain at measuring resistors



Von Mises stress distribution by FEM

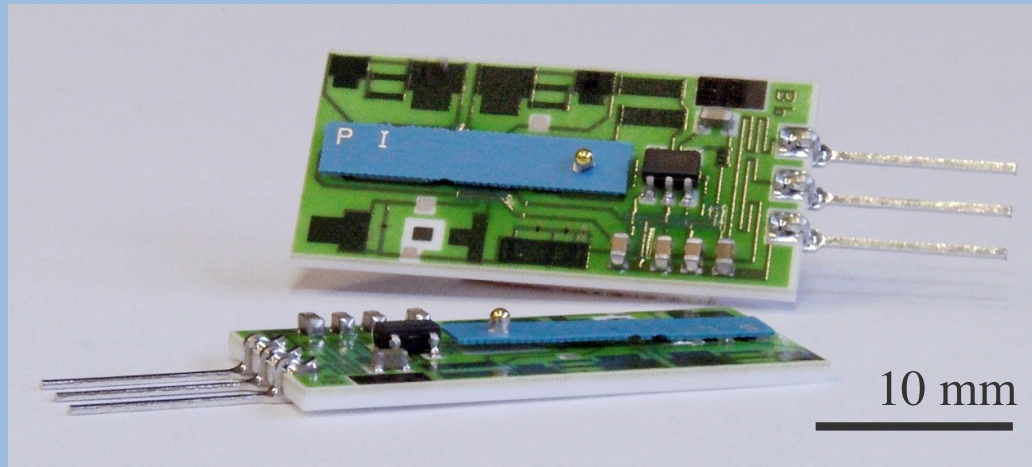
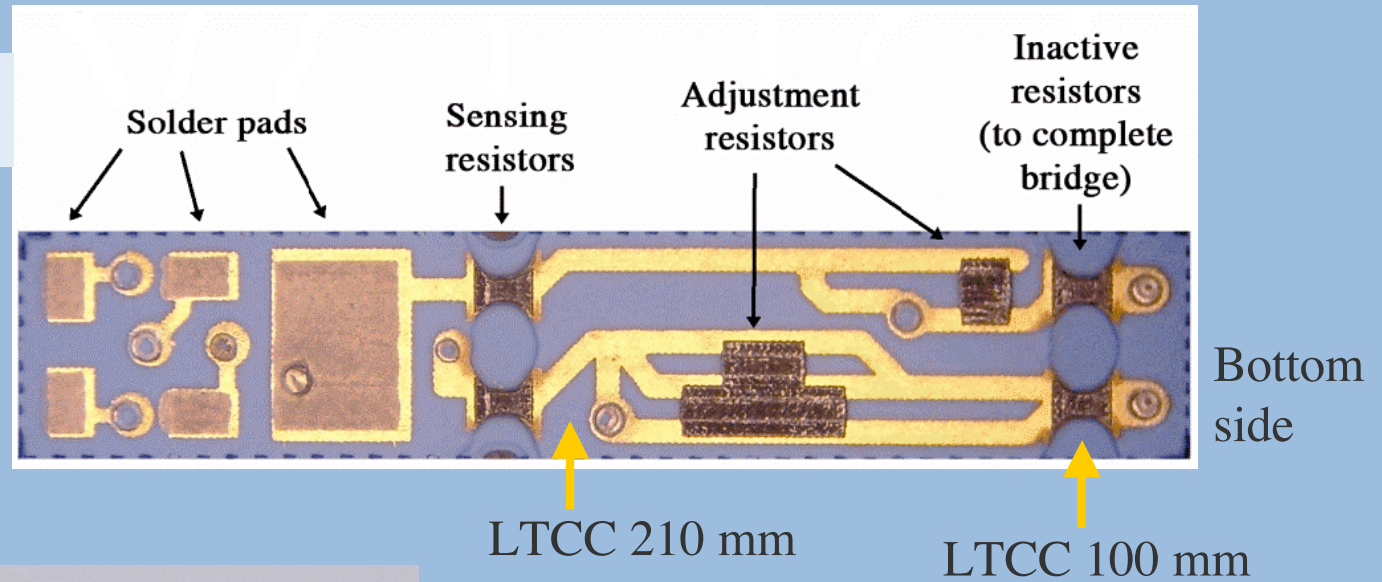




# Force sensor



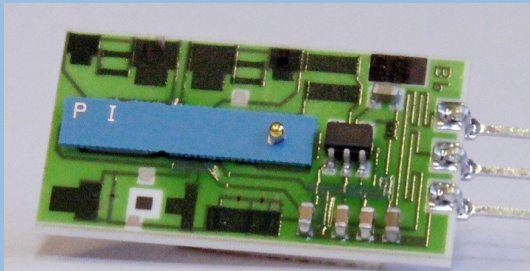
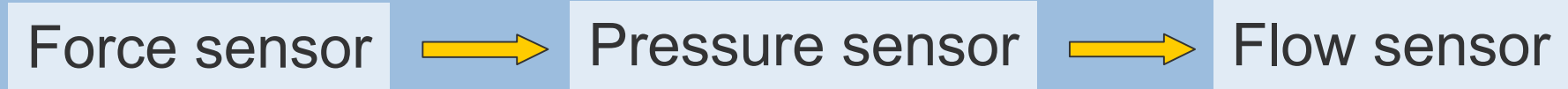
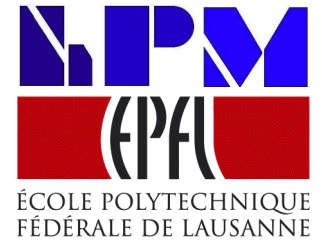
## LTCC cantilever



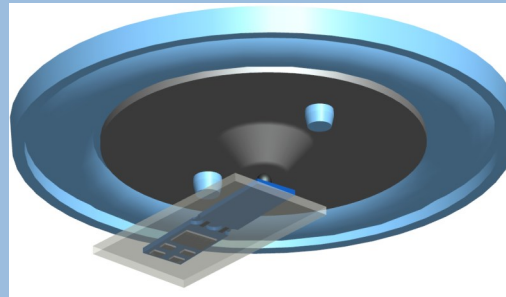
100 mN force sensor



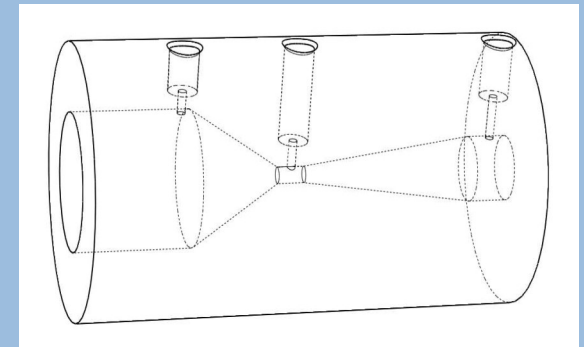
# Assembly



LTCC cantilever

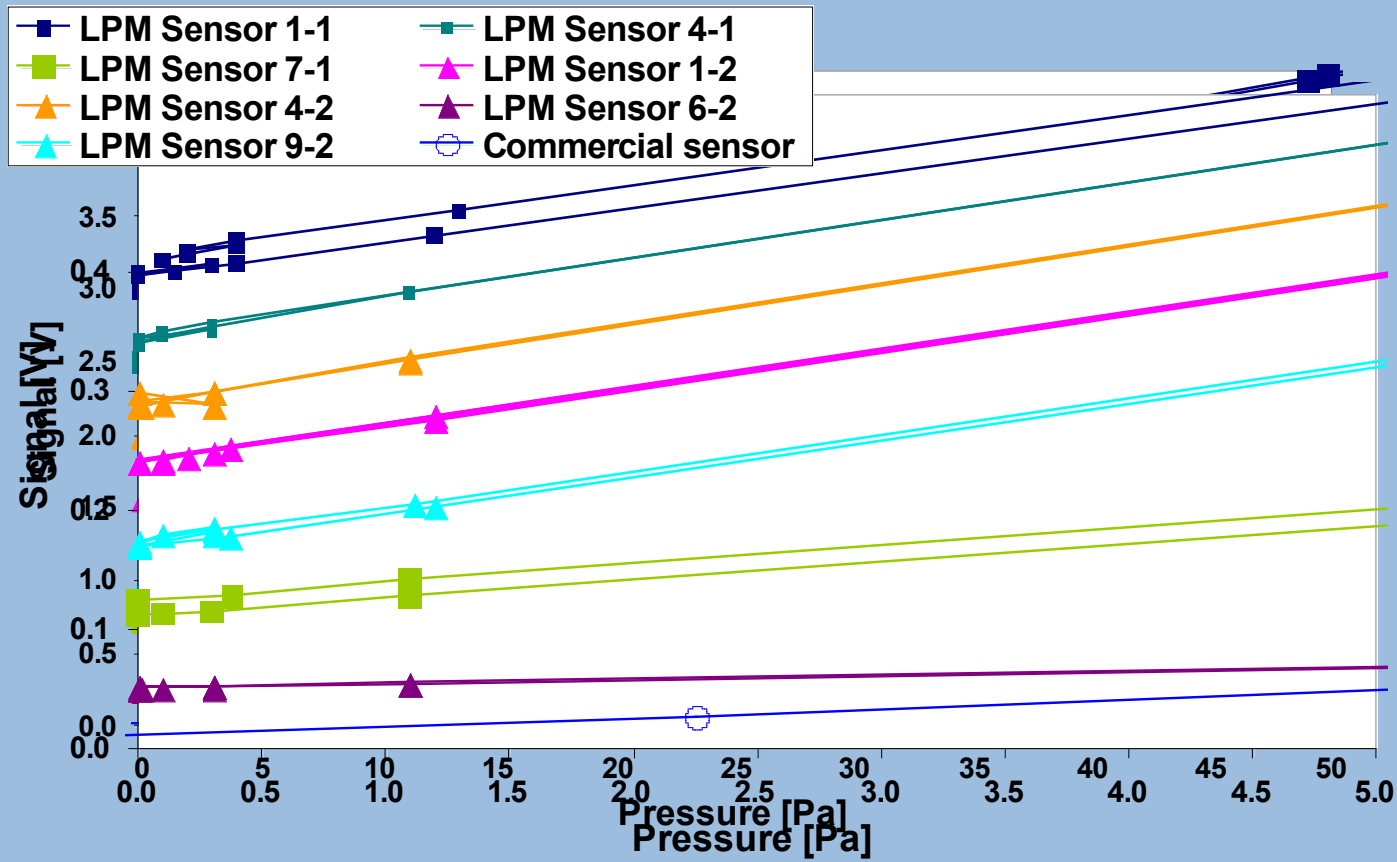
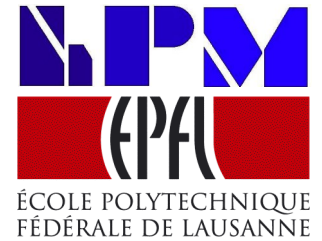


Membrane



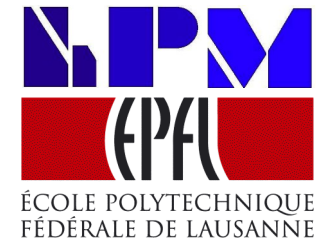
Venturi

# Characterisation



Signal from 0.2 Pa & 1ml/s

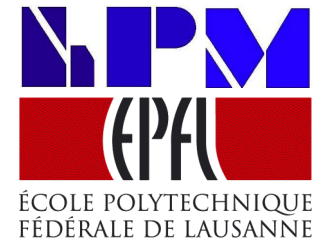
# Conclusion & Outlook



- Ultra-low pressure sensor sensitive to 1Pa
- Accurate measurements of very small air flows
- Venturis with
  - High pressure drop
  - Lower pressure losses



# Ultra-low pressure sensor for neonatal resuscitator



Thank you for  
your attention!