Packaging Technologies for Love-wave-based Microbalance for Fluid Analysis

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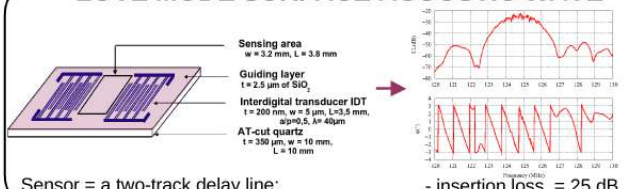
INTRODUCTION

- Love mode: shear-horizontal surface acoustic wave guided by SiO_2 layer coatings on a piezoelectric substrate
- Love wave: generated thanks to the Interdigital transducers (IDTs) on a piezoelectric substrate
- **Purpose of the research**: design and manufacture of the packaging for Love wave sensors at the wafer scale level
  → to allow for operation with liquid media

LOVE MODE SURFACE ACOUSTIC WAVE



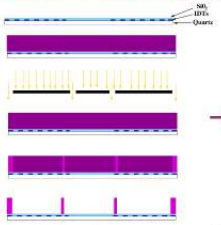
Sensor = a two-track delay line:
the reference and the sensing lines

- insertion loss = 25 dB
- Baseline = - 50 dB

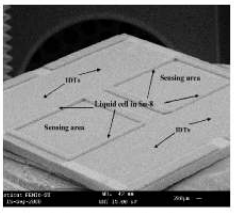
MICROFLUIDIC PACKAGING

Liquids used in experiments may prevent the IDTs' operation
↳ attenuation of the acoustic signal due to capacitive coupling
↳ fabrication a liquid cell isolating the sensing area & the IDTs

1- SU-8 / PDMS liquide cell



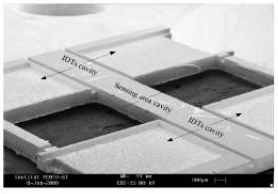
SU-8 walls fabrication steps



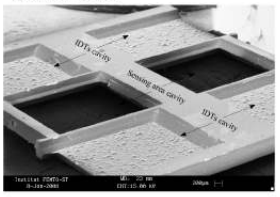
SEM image of the SAW device withSU-8 cell

2- Silicon & quartz liquid cell fabrication

*** Silicon cover**

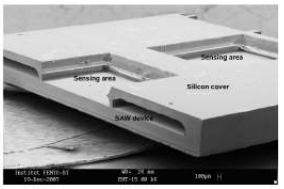


*** Quartz cover**



*** Packaging the SAW sensors**

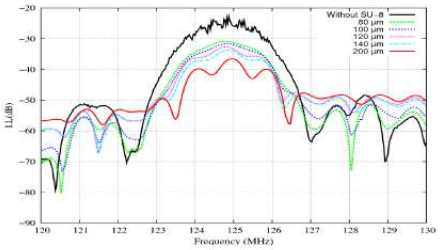
→ SAW sensors + silicon or quartz
↳ glued the cover plate on the SAW:
- using a thin SU-8 dry film
- EVG wafer bonding machine (F = 15 N, T = 95°C)



RESULTS

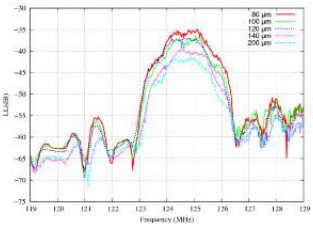
Once the fabrication achieved:
↳ evaluate the velocity and propagation loss using a network analyzer to measure the influence of the proposed packaging approaches on the principal wave characteristics.
→ several wall widths tested to evaluate the influence of this parameter on the attenuation of the acoustic wave.

Evolution of the insertion loss of SU-8 liquid cell

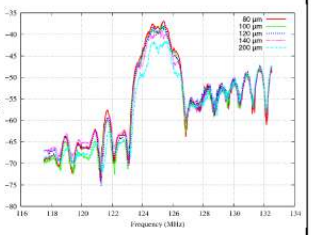


Evolution of the insertion loss of silicon & quartz liquid cell

*** with silicon cover**



*** With quartz cover**



→ Silicon : 1 mm, resistivity = 5 kΩ.cm; Quartz: Zxl 1.5°, 1 mm

FUTURE POLYMERS FOR SAW SENSORS PACKAGING

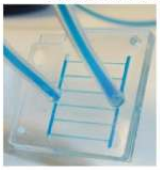
Cyclic Olefin Copolymer (COC): increasingly popular as substrate material for microfluidics

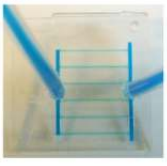
Promising properties: high chemical resistance, low water absorption, good optical transparency and ease of fabrication

Fabrication: injection molding using a metallic master (Al, Ni..)

Packaging : COC microfluidic + SAW devices
↳ using ORDYLSY300 dry film photo-resit

Thermal bonded COC chips:
- 20 mm² * 2 mm Thickness
- Channels width : 100, 300 µm
- 2,6 hole diameter





Conclusion

- The two technological approaches for packaging SAW sensors presented here are both compatible with wafer-level batch processes and yield acceptable acoustic losses considering a delay line configuration on quartz.
- Cyclic olefin Copolymer could be considered as a new candidate for the packaging of the SAW sensors for their promising properties.