Characterization of Microcantilever Resonators

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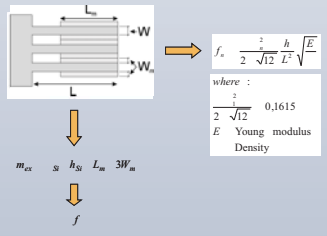
Microcantilever resonators

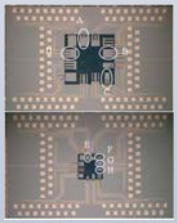
Advantages

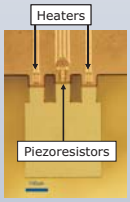
- Sensitivity
- Stability
- Simplicity
- Reduce size
- Low power consumption
- Repeatability
- Integrability

Approach



Description





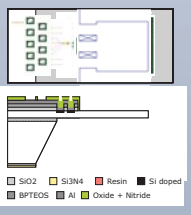
Dimensions

Structure type	Length of the beam L (µm)	Width of the beam W(µm)	Length of the extra mass L_m (µm)	Width of the extra mass W_m(µm)
A	400	64	300	36
B	400	92	235	8
C	400	50	235	8
D	400	84	200	16
E	200	32	150	18
F	200	28	25	22
G*	200	150	0	0
H	200	20/34/20	185	6

For all the beams the thickness is 15µm.
*The structure type G was designed as a whole cantilever.

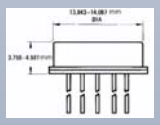
Process Sequence

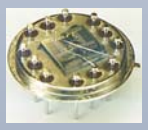
1. Wafer preparation
2. Active zone mask
3. Backside mask
4. Heaters and piezoresistances definition
5. Contacts definition
6. Metallization
7. Passivation
8. Pattern definition
9. Structure release



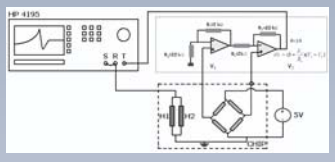
Packaging

T-08 Metal can package
Wire bonding



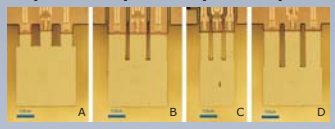


Experimental Setup



Frequency response (Chip 1)

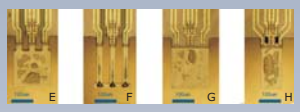
Fs=92kHz Q=873 | Fs=107,3kHz Q=771 | Fs=101,9kHz Q=863 | Fs=102,9kHz Q=856



Interferometric measurement difference< 5%
Simulation (percentage difference) ~ 14%

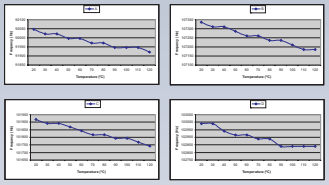
Frequency response (Chip 2)

Fs=333,5kHz Q=1196 | Fs=402,2kHz Q=935 | Fs=439,1kHz Q=931 | Fs=434,4kHz Q=1108

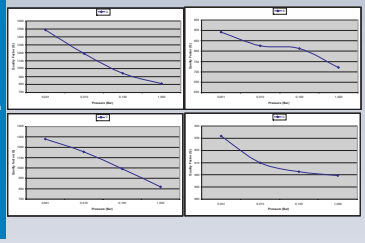


Interferometric measurement difference < 5%
Simulation (percentage difference) ~ 17%

Frequency vs. Temperature (Chip 1)



Quality Factor vs. Pressure (Chip 1)



Conclusions

For structures of dimensions in the range of 400x300µm² the first mode of resonance was around of 100kHz.

For structures of dimensions in the range of 200x150µm² the first mode of resonance was around of 400kHz.

Measured quality factor between 800 and 1100 in air.

The resonance frequency slightly change with temperature (20 up to 120ºC). No perceptible change with humidity.

The used approach was more accurate (error~15%) than the classical one (error~30%).

Results commensurate with previous designs and simulations.

Future work

Althoug simulations showed good agreement with experimental results; the simulation model must be enhanced including some factors such as: damping, stress (due to fabrication process) and more realistic material constants values.

Study the possibility of use temperature compensation.

An extension of this work, deposit polymer on the cantilever, could be used to study the cantilever sensitivity and its application as a sensor.

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