

System-in-package for a carbon nanotube resonator

Rokhaya Gueye, Terunobu Akiyama, Danick Briand, Nico F. de Rooij

Ecole Polytechnique Fédérale de Lausanne (EPFL)

Sensors Actuators and Microsystems Laboratory (SAMPLAB)

Abstract

The aim of the Nano-Tera project CabTuRes is to develop a 3D integrated Carbon Nanotube (CNT) resonator for sensing and electronics. The developed system-in-package provided a vacuum sealed glass cap and a CMOS interface circuit assembly to the CNT resonator. In this project, "via-first" Pt-TSVs were fabricated in KOH cavities. The 3D electrical interconnects created an ohmic contact to the SOI silicon device layer. They were designed for high-temperature post-processing and radio frequency range operation.

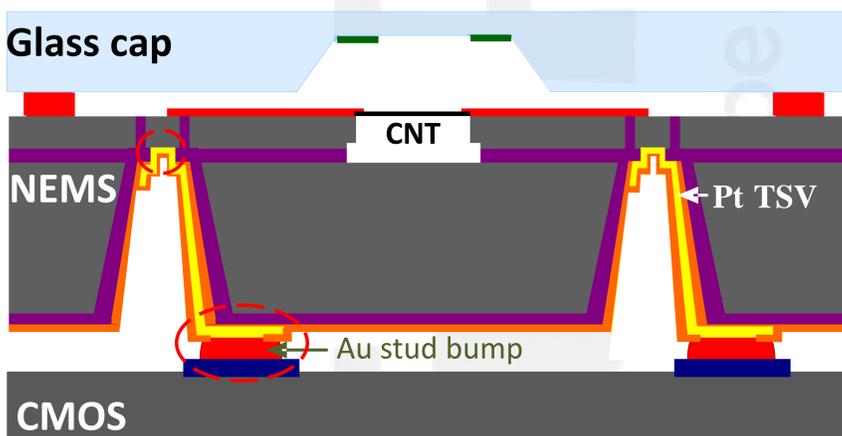


Figure 1: System-in-Package concept for the 3D integration of a carbon nanotube resonator.

Conclusion

An SiP was developed for a SWCNT resonator. An hermetically sealed glass cap was processed using eutectic bonding. The NEMS and CMOS chip assembly was via gold stud bumps.

The TSVs were designed for high-temperature post-processing and radio frequency range operation. The first characterization results have shown that these Pt-TSVs are suitable for an RF-NEMS "via-first" 3D integration.

Acknowledgement

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Glass cap

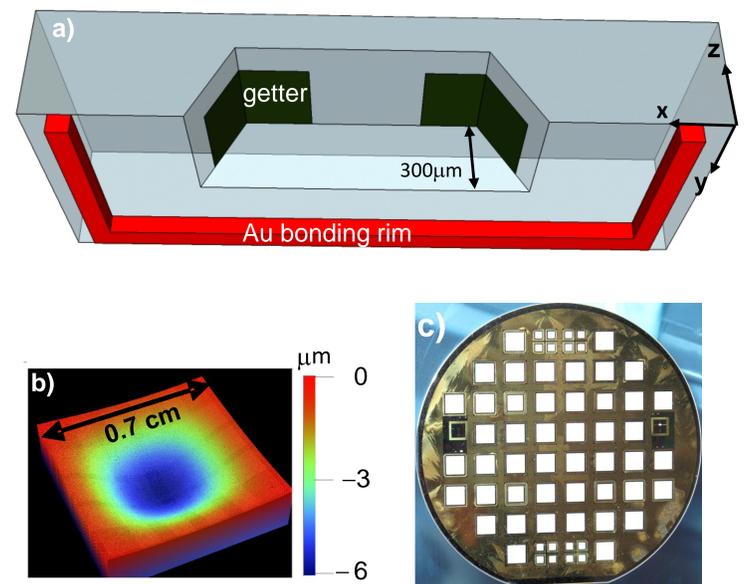


Figure 2: a) Chip scale sketch of the cap b) 3D reconstruction of the cap deflection after bonding c) Optical picture of the glass cap wafer eutectic bonded to a Si substrate.

High-temperature TSVs

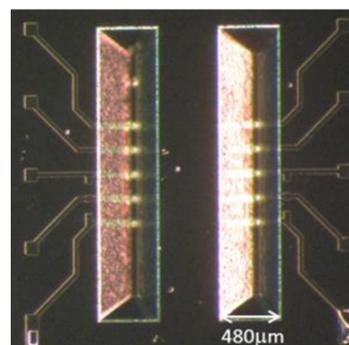


Figure 3: Optical image of the backside of a chip with 10 Pt-TSVs.

A chip with 10 Pt-TSVs.

- KOH etching
- Insulation: SiO₂ and Si₃N₄
- Ta/Pt metal
- Si₃N₄ passivation



Figure 5: NEMS-CMOS assembly on dummy chips.

Publications

R. Gueye et al., Proc. Engineering (vol. 25), pp. 1513-1516 (2011).

R. Gueye et al., Sensors and Actuators A, 191, pp.45-50 (2013).

R. Gueye et al., Proc. SPIE 8614 (2013).

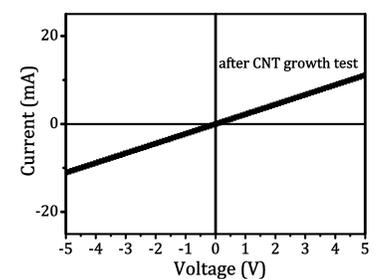


Figure 4: I-V curve of Pt-TSVs

Passivated Pt-TSVs are compatible with a CNT growth process at 850°C.

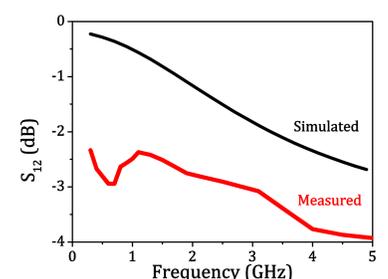


Figure 6: Transmission coefficient on a ground-signal-ground RF test structure.