

Robust Fulcrum-Type Wafer-Level Packaged MEMS Switches Utilizing Al-Ru-AICu Contacts Fabricated in a Commercial MEMS Foundry

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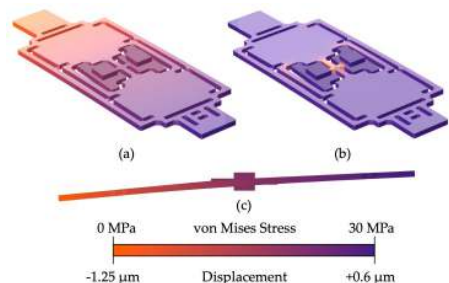
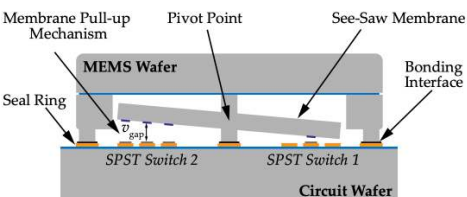
STATUS QUO

- From past two decades, advancements in RF MEMS switches have provide unique solutions to tunable devices.
- RF-MEMS usually suffer from reliability concerns including beam warping, contact degradation, high switching time and stiction.
- Hermetically sealed wafer level packaged devices are designed and fabricated to mitigate such concerns in a commercial MEMS foundry.
- Unique materials and thick silicon core for robust switching operation is demonstrated with exceptional RF performance.

NEW INSIGHTS

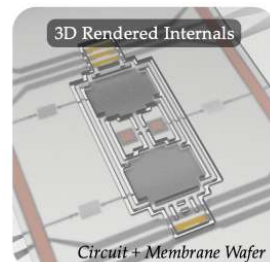
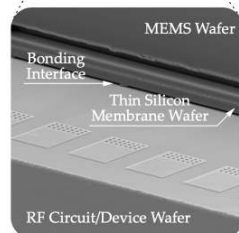
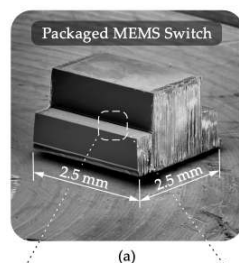
- Fulcrum-type MEMS switches in hermetically wafer-level packaging.

Redundancy Matrix using transfer switches.

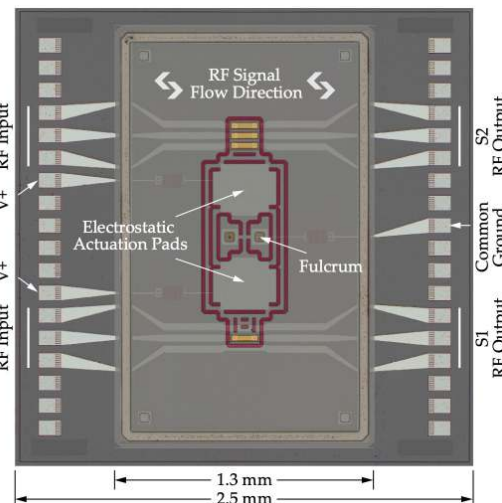
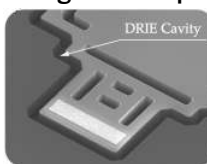


- Improved isolation and low insertion loss
- Stresses are minimized utilizing a thick silicon core structure.
- No electrical vias or pass-throughs required.
- High switching speed and improved reliability due to the use of Al-Ru-AICu contacts to minimize contact degradation
- 20 mask process with three wafers eutectic bonding.

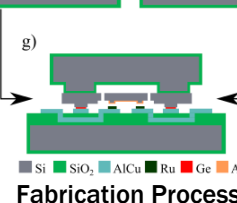
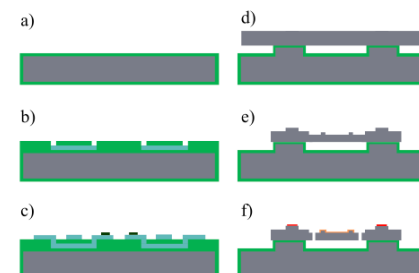
DESCRIPTION



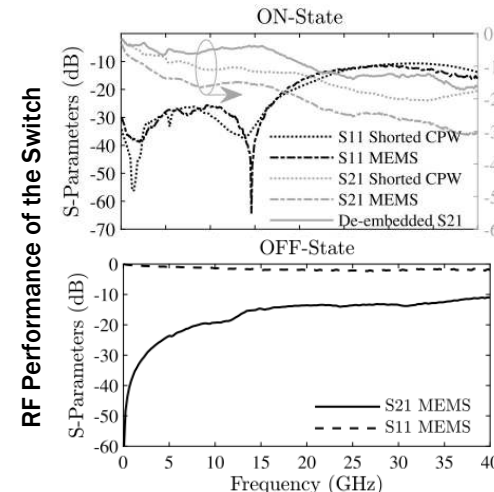
Single and Triple Contact Switches



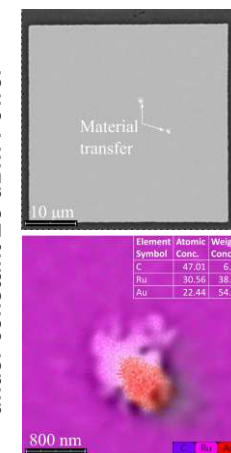
Parallel Device Wafer and MEMS Wafer Processing



QUANTITATIVE IMPACT



Ru/AICu Contacts after 6e6 cycles under constant 20 dBm Power



DC-14 GHz
Packaged Switch

- Insertion Loss < 0.2 dB
- Isolation > 20 dB

> 4e6 cycles

PROPOSED CONCEPT GOALS

- A highly reliable robust wafer level packaged RF MEMS switch.
- See-saw type mechanism that provides two unique and independent RF switches in a single hermetically sealed packaged (< 2.5 mm)
- Non-metallic thick silicon core to improve mechanical robustness.
- Au-Ru-AICu metal contacts minimizes any micro-welding and contact degradation issues while silicon core provides warm free beams.
- Eutectic packaging approach to minimize any post release packaging issues and minimize any vibration related damages.