Nanowire-based Through Substrate Via for Millimeter-Wave Frequencies

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Introduction

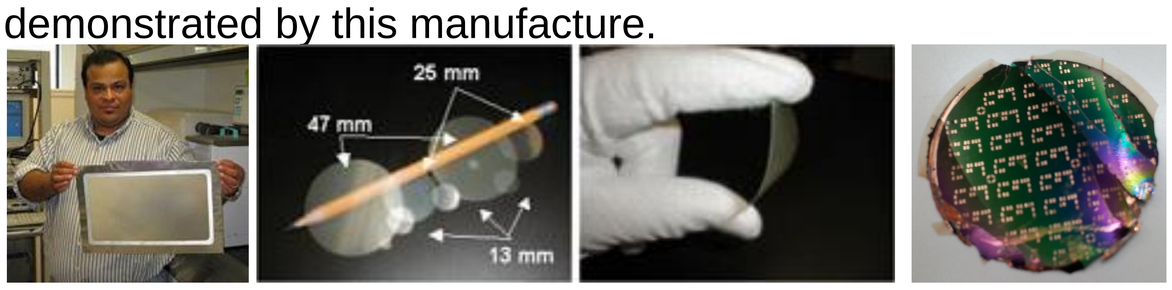
Nowadays, 2.5D-3D IC integration using silicon interposer and through silicon via (TSV) to diminish the signal propagation delay are being explored to address the routing problem between different ICs. As silicon technologies have been progressively expanded into the millimeter-wave (mmW) range, routing high-frequencies signals using TSV becomes a challenge, because of parasitic effects of silicon. HR Si is an alternative, with increased costs.

To overcome the TSV issues and improve integration in mmW, the research of alternative technologies is justified. As examples, glass and organic interposers, such as liquid crystal polymer (LCP), appear as alternatives to silicon presenting high quality through substrate vias.

In this context, this poster presents a new type of low-cost through substrate via for mmW frequencies, with easy fabrication process, using the MnM substrate.

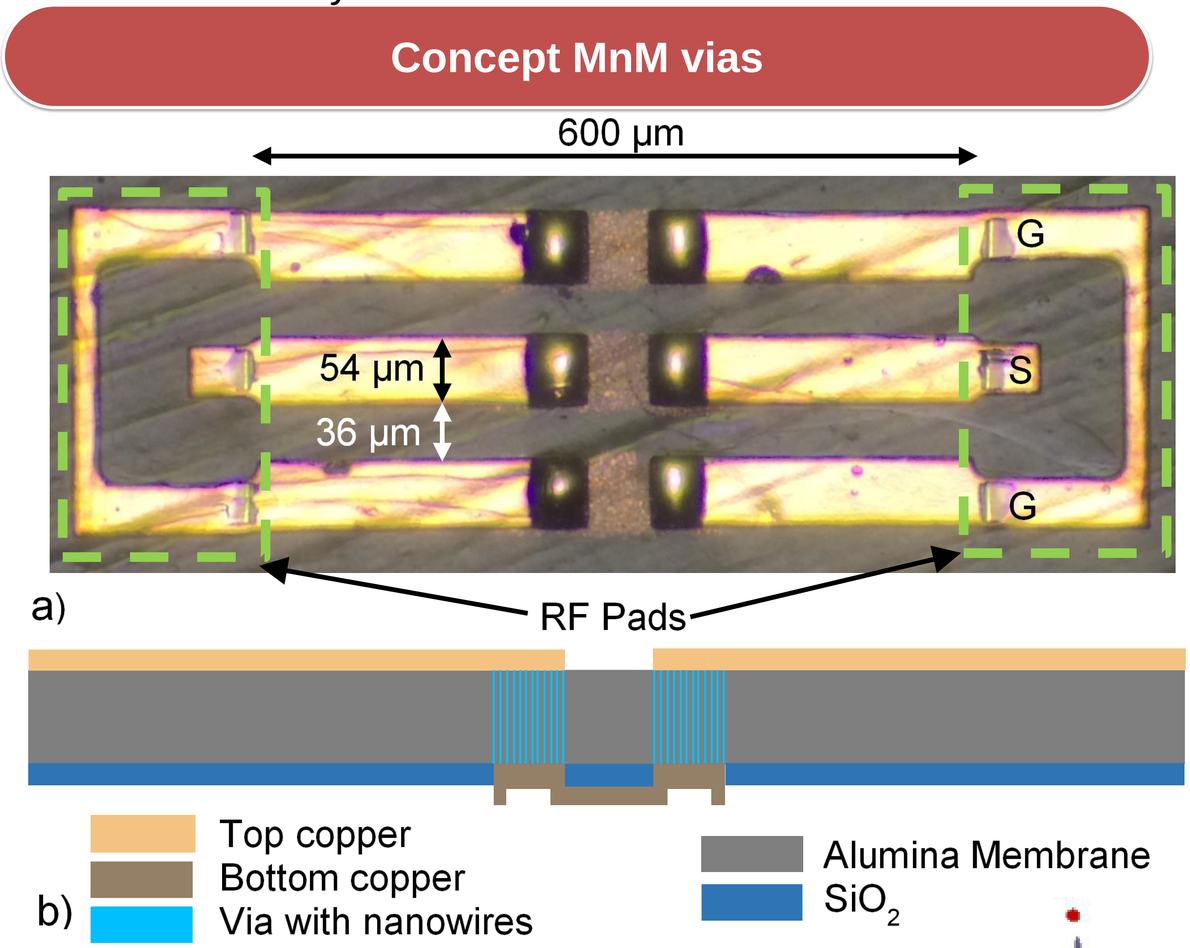
The MnM Substrate/Interposer

The MnM substrate is based on a nanoporous alumina substrate that has numerous benefits. Alumina is an excellent insulator with low loss at high frequencies. Typically, the diameter of the nanopores can range from 20 nm to 400 nm, and the interpore distance from a few tenths to a few hundreds of nanometers. The nanopores can be easily filled with metal by electrodeposition. The nanowires can yield slow wave effect transmission lines with high quality factor, which allows the fabrication of miniaturized microstrip lines with low characteristic impedance. In this work, 50-µm-thick membranes from Synkera Technologies Inc. with 55-nm pore and 143-nm interpore distance were used. The fabrication of these membranes can be scaled as demonstrated by this manufacture.

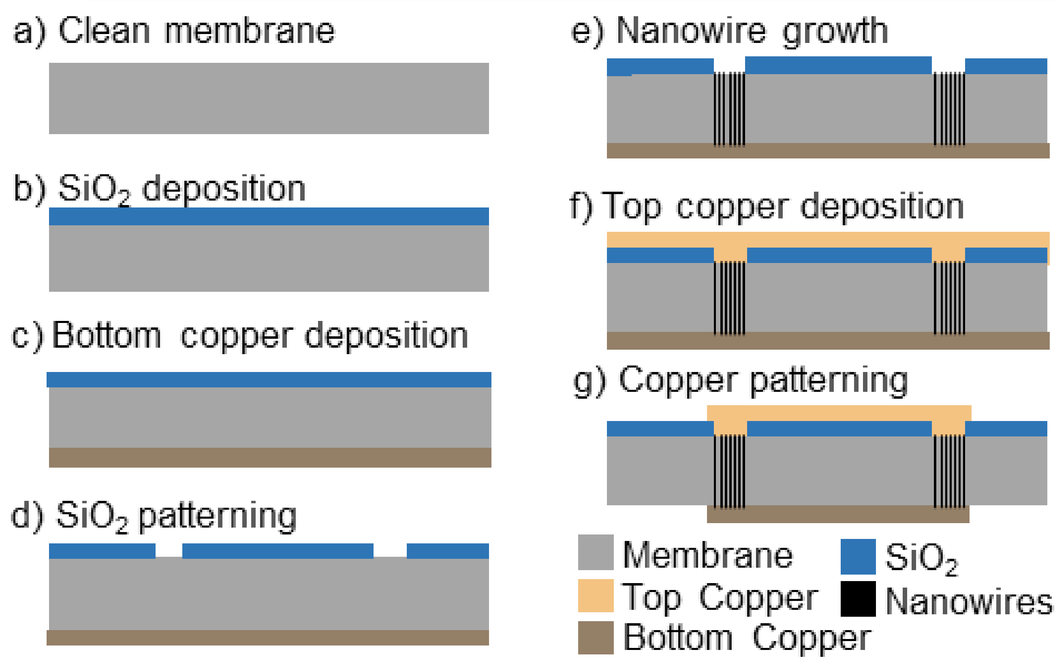


www.synkera.com

Concept MnM vias

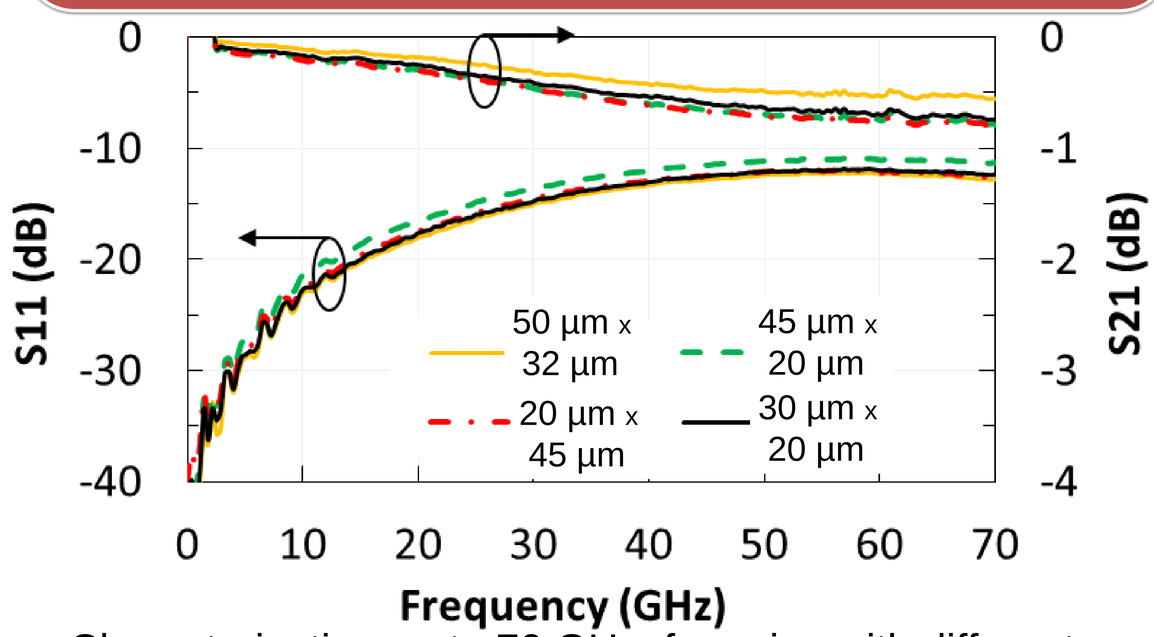


Fabrication Process



The fabrication vias is straightforward. Unlike other technologies, there is no need to etch the substrate since it presents native nanopores, reducing costs and size. The via diameter depends only on the resolution of the photolithography process that selects the desired via surface filled with several nanowires. It is also possible in the proposed technology the fabrication of high-density vias regions for high-density interconnections.

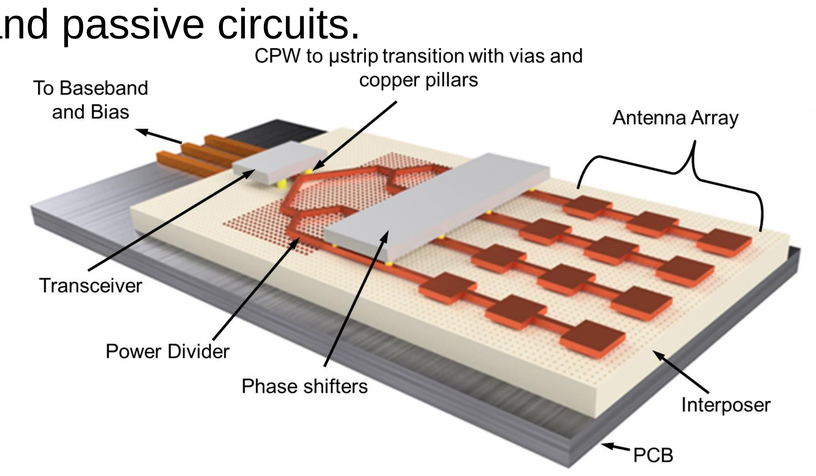
Measurements



- Characterization up to 70 GHz, four vias with different areas
- Insertion loss < 1 dB @ 70 GHz - Whole structure
- Only Via: < 0.2 dB @ 70 GHz – State-of-the-art!

MnM Substrate Ultimate Goal

To serve as an interposer for connecting heterogeneous technologies for mmW applications, focused in the consumer market, with high quality transmission lines, vias and passive circuits.



Acknowledgments

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