Flexible RF-Electronics based on Non-Volatile Nano-Ionic Switches

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In this article we present the possibility of Nafion based nano-ionic conductive bridging non-volatile switches for RF applications on flexible paper substrate, generally known as Conductive Bridging Random Access Memory (CBRAM) [1], [2]. The presented technology is fully passive and non-volatile and is fabricated without the need of a clean room environment [3]. This technique has comparable performance features, at least up to 3GHz, to renowned switching solutions like the MEMS and other non-volatile switch techniques [3]. The switching cell is comparable to a parallel plate capacitor with one of the electrodes electrochemically active like silver or copper and the other electrode relatively inert like aluminum or gold. And the electrolyte is an Ion-Conductor like Nafion or Poly-methyl-methacrylate (PMMA). The unique geometry gives the name Metal-Insulator-Metal (MIM) switch to the device.

The application of this technique is now tried on a low cost and flexible substrate like paper. We present the design and results of a CPW shunt mode switch on paper and a one bit RF resonator for chipless RFID application on Paper substrate. Silver and Aluminum are used respectively as the active and inert electrodes and Nafion is used as the electrolyte in this realization. Thermal vapor deposition is used to form the metal layers and the electrolyte is spin coated to form a sandwich structure as described above. Photograph and results of CPW shunt mode are shown in the Fig. 1 (a, c). The presented RF resonator is basically a 1-bit chipless RFID tag which could be electronically reconfigured to resonate at two different frequencies depending on the switch position (Set/Reset). The photograph and results of the tag is shown in the Fig. 1 (b, d).

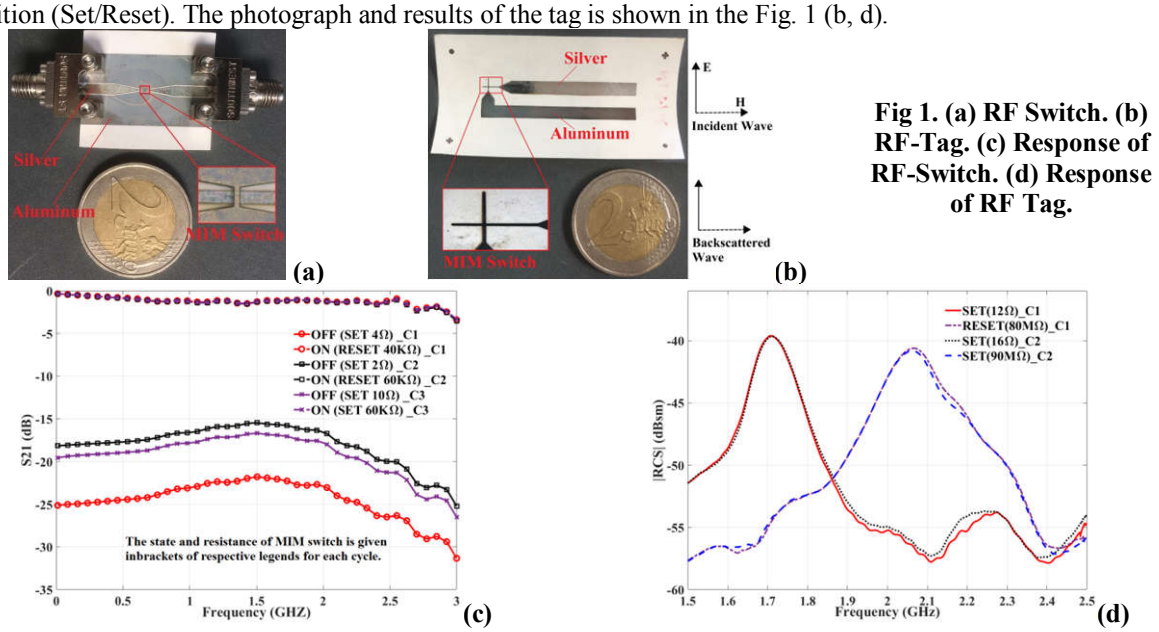

Fig 1. (a) RF Switch. (b) RF-Tag. (c) Response of RF-Switch. (d) Response of RF Tag.

The presented results are repeatable and reproducible. The devices are tested for a repetition cycle of more than 50 cycles for several batches. The presented devices also have the potential to be printed using an inkjet printer as a whole 'electronically reconfigurable RFID tag'. This could be done by printing using conductive Inks and electrolyte.

References

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