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The memristor switching behavior from the energetic point of view

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Since the solid-state memristive devices were carried-out many research centers has tremendously increased their efforts towards the memory design and controllable memory blocks. One of the aspect of switching mechanism test is the energy required for the setting and resetting the memristive element.

In the presentation author would like to focus on the mentioned problem. There were carried out some measurement tests over the self-directed channel (SDC) memristive device (thanks to the courtesy of Knowm Inc.). This device is an ion-conducting memristor comprised of the layered chalcogenide materials Ge_2Se_3/SnSe/Ag (fig 1) [1].

After the AC tests of the element, the characteristic has been fit to the models. There are many models that can be used to simulate the memristors behavior. First and the simplest one has be proposed by the Strukov et al. [2] the more comprehensive is introduced by Strachan et al. [3]. In the presentation there will presented both fitting simulation. As the Strukov proposal is symmetric in the mean of voltage polarization cannot be the one that reflects the real memristor behavior in sufficient way. On the other hand Strachan model is very complex and requires many fitting parameters so the space of the possible solutions is big. Using the fitting algorithm that minimizes the mean square error between the real data and the model in this case, gives the quite poor solutions. To work around the problem author propose of introducing some non-deterministic algorithms where we are not sure that global minimum is found, but the found solutions gives quite similar characteristic.

After the model was found the test with other voltage shape has been carried out. In the test author has calculate the total charge, power and energy dissipated in element while switching process.

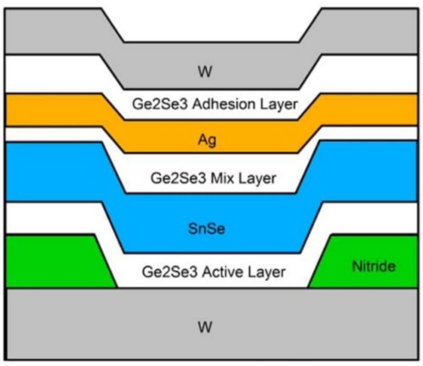

Figure 1: Tested SDC memristor device structure.

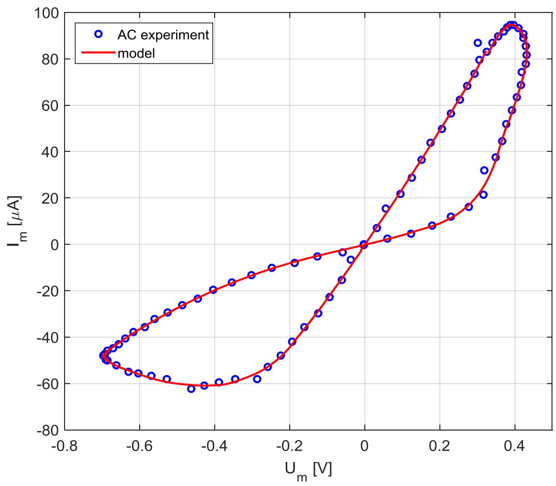

Figure 2: Modeling sinusoidal excitation.

References

[1] K. A. Campbell, Self-directed channel memristor for high temperature operation *Microelectronics J*. vol. 59, January 2017, pp.10-14

[2] D. B. Strukov et al. The missing memristor found *Nature*. **453**, 2018**,** pp. 80–83

[3] J. P. Strachan et al. State Dynamics and Modeling of Tantalum Oxide Memristors, IEEE TRANS. ON ELECTRON DEVICES, VOL. 60, NO. 7, 2013, pp. 2194-2202