Synaptic devices implemented in two-dimensional layered single crystal chromium thiophosphate ($CrPS_4$).

Sangik Lee[1], Mi Jung Lee[1], Chansoo Yoon[1], Sungmin Lee[2], Jun Tae Jang[3], Dae Hwan Kim[3], Je-Geun Park[2] and Bae Ho Park[1*]

[1]Division of Quantum Phases and Devices Department of Physics, Konkuk University, Seoul 05029, South Korea
[2]Department of Physics and Astronomy, Seoul National University, Seoul 08826, South Korea
[3]School of electrical engineering, Kookmin university, Seoul 136-702, South Korea

Sangik1129@gmail.com

The development of reliable memristor devices capable of storing multiple states of information has opened up new applications as neuromorphic computing[1,2]. Recently, Reported ion migration based synaptic memristor devices using two-dimensional (2D) layered transition metal dichalcogenides (TMDs) materials such as MoS_2 and WS_2. Native oxidized layer of sub nanometer thickness exhibits excellent synaptic plasticity and learning capacity close to the ~100mV level of neuron spike by electrically induced oxygen vacancy conductive bridge.[3] However, these devices has dimension limit as reducibility total thickness due to Native oxidized MoOx/MoS_2 and WOx/WS_2 heterostructure.

In this work, we fabricated memristor devices of M/I/M capacitor structures using 2D layered $CrPS_4$ single crystal electrolyte. It is used insulator part as electrolyte with controlled difference thickness by mechanical exfoliation method. We observed current-voltage (*I-V*) curves of bipolar resistive switching (RS) behaviors which occurred at low switching voltage with high on/off ratio. Furthermore, we demonstrated in our device including cation movements with multiple resistance states are controlled through repeated stimulation.

Figures

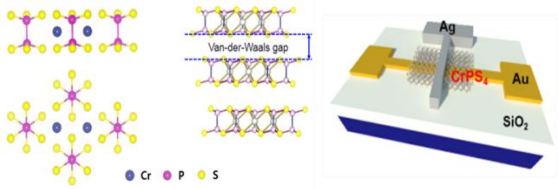

Figure 1. Schematic image of memristor device and 2d layered structure of $CrPS_4$.

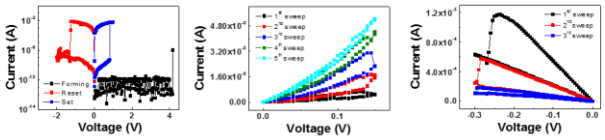

Figure 2. Resistive switching behaviors of memristor devoce.

References

[1] Yang, J. J., Strukov, D. B. & Stewart, D. R. Nat. Nanotech. 8(2013), 13–24.
[2] Borghetti, J. *et al*. Nature 464(2010), 873–876 .
[3] Bessonov, A. *et al.* Nat. Mater. 14(2015) ,199–204 .