ASPIRE League Partnership Seed Fund
2nd (2020) Round – Project 3
Research Project Summary

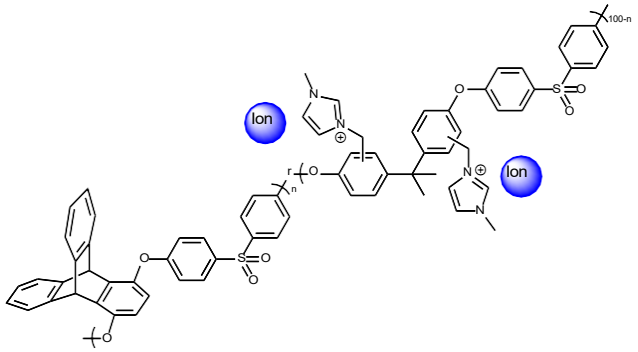
Q1. Title of Research Project
Faster and Reproducible Neuromorphic Computing Using Porous Ion Transport Membranes
Q2. Timeframe
Project Start: 01/08/20 Project Completion: 31/07/22
Q3. Project Synopsis

Objectives.

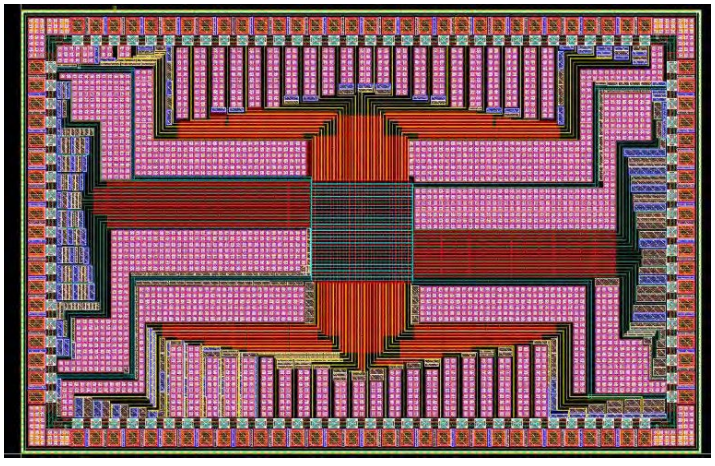
1. To make porous and ion-conducting polymer. The polymer here is expected to transport a specific type of ion.
2. To make neuromorphic computing devices using the polymer as a memristor device.
3. To optimize the polymer structure and porosity to enable improved neuromorphic computing

Outputs.

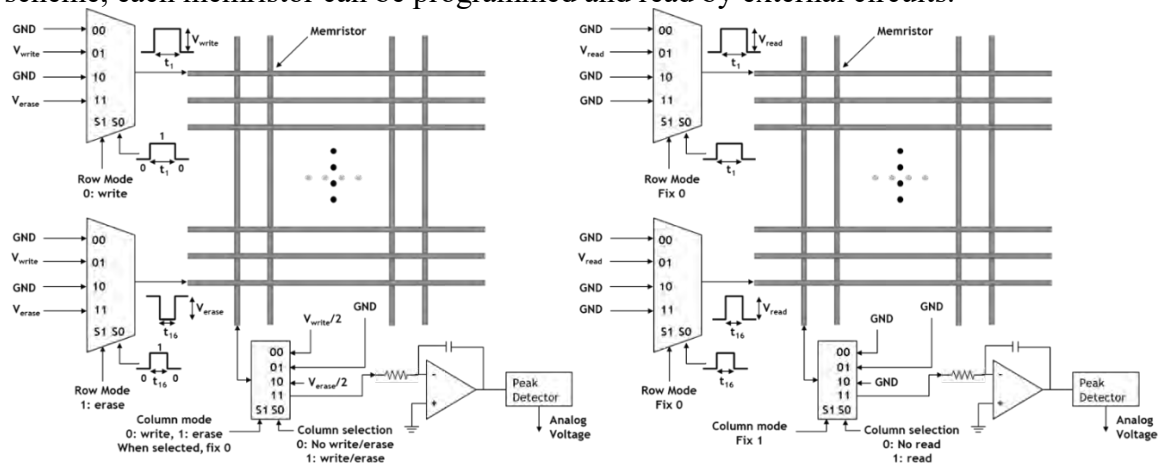
Synthesized ion-conducting block copolymer (See the structure below). The porosity in the structure allows specific ions to transport.



The chip has been built to integrate a copolymer-based memristor network. This chip is for selecting individual memristors in vertical integration systems.

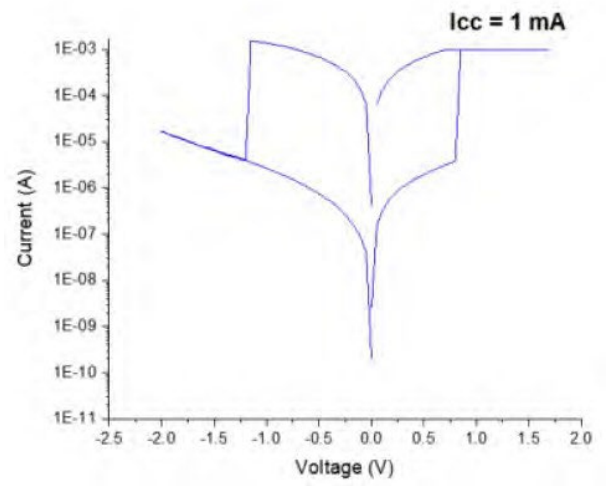


Memristor array operating System development for copolymer-based memristor. Using this scheme, each memristor can be programmed and read by external circuits.

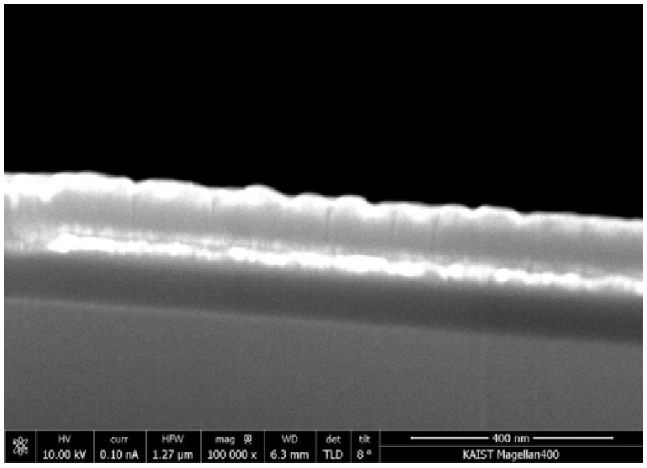


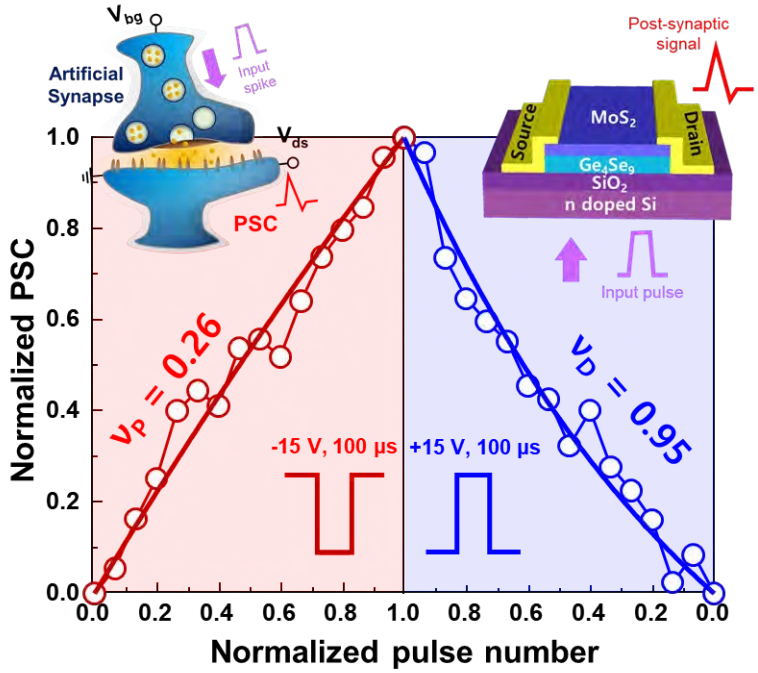
Write/Erase **Read**

The expected I-V curve from the ion-conducting block copolymer-based memristor shows hysteresis. This large on/off ratio in the hysteresis can be used as a memory.



The expected layer deposition from copolymer-based materials This layer will be used as a switching medium for ion transport and achieve memristive behavior.





MoS_2/Ge_4Se_9 synaptic device exhibited stable post-synaptic current (PSC) modulation based on interfacial charge transfer. Over the 2,000 cycles, the MoS_2/Ge_4Se_9 synaptic device showed a high repeatability and linear conductance modulation for potentiation and depression behavior by applying the pulse with ±15 V for 100 μs. It is noteworthy that MoS_2/Ge_4Se_9 synaptic device exhibited the low non-linearity of $\upsilon_{PP} = 0.26$ and $\upsilon_{DD} = 0.95$, respectively, which was competitive with previous 2D synaptic memtransistor devices. Furthermore, MoS_2/Ge_4Se_9 synaptic device has low operating energy consumption; 15 fJ for updating energy / 40 fJ for reading energy.