Emerging materials for Bio-inspired neuromorphic computing applications

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Although there has been progress in Neuromorphic computing, however, engineering the material aspect for its architecture remains a challenge. In this regard, the two-dimensional (2D) layered materials, consisting of atomically thin layers, possess a plethora of exotic properties and have emerged as the leading contenders for the next generation of electronic devices. Specific attention has been given to the layered transition metal dichalcogenides (TMDCs), has created numerous prospects for developing low-power electronics, cutting-edge memory device arrays and smart computing architectures with desirable miniaturization. In this talk I will discuss two approaches for achieving Neuromorphic computing with monolayer TMDCs mem-transistors; optoelectronic and thermal driven ionotronic approach. Two-dimensional TMDC transistors demonstrating optoelectronic artificial synapse and reconfigurable logic operation are fabricated. The persistent photoconductivity of these devices are used to achieve the long- short term synaptic plasticity behaviour. Furthermore, Pavlov's classical conditioning is demonstrated by using the broadband sensitivity of the devices. More importantly, reconfigurable Boolean logic gate operations are demonstrated within the same device. We also demonstrate a novel mem-transistor device using monolayer TMDCs as channel that offers multi-bit high density storage states and can perform key synaptic operations above room temperature. This novel integration of memory, synaptic behaviour, and processing within a single monolayer TMDC device put forth a new horizon for the Non-Von-Neuman type in-memory computing architecture for advanced AI applications at room temperature and beyond. I will also discuss on some metal oxide based neuromorphic computing applications.

Reference:

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