Bose Colloquium

S. N. Bose National Centre for Basic Sciences
(An Autonomous Research Institute established under DST, GOI)

Title:

Neuromorphic devices based on self-formed Ag nano-labyrinth structure

Abstract:

The human brain, comprising nearly a hundred billion neurons with several order higher number of synapses, accomplishes massive parallel processing and unmatched cognitive actions. Inspired by this, efforts are being made worldwide to develop artificial neural networks to mimic intelligence with the help of complex algorithms incorporated on the currently available high-speed computational platforms. However, solving intricate real-world problems which a biological brain routinely deals with in real time, have posed tremendous challenges even to the state-of-the-art computers. A biological synaptic junction, unlike the present day computing units, appears to handle both processing and memory parallelly, an aspect closely linked to its ability to change with the circumstance, termed neuroplasticity. While neuroplasticity in relation to memory and processing is still being investigated, efforts in the literature are increasingly based on mimicking different levels of neuroplasticity using artificial synaptic devices.

The presentation covers the literature on this topic with emphasis on self-forming device recipes. A self-formed labyrinth structure of Ag, mimicking neuronal bodies and axonal network connectivity (at least remotely), has been explored in the laboratory and the outcome of the study will be described. This interesting device architecture enabled us to emulate using voltage spike signals, basic to complex synaptic activities, importantly, without the aid of CMOS circuitry. Besides short- and long-term potentiation, behaviours akin to human intelligence have been realized. Another important feature is the linear updation of the synaptic weight which serves for in-memory computation, opening up new horizons away from von Neumann architecure.

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4.00 PM

At Fermion

You Tube YouTube Link

Webinar Link

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Short Biography of the Speaker:

Professor Kulkarni obtained his Ph.D. from Indian Institute of Science in 1992. Subsequently he did post-doctoral research in IISc and Cardiff University and then joined JNCASR, Bangalore as a faculty in 1995. He served at JNCASR until 2015 as he became the Director at Centre for Nano and Soft Matter Sciences, Bangalore in 2015. Prof. Kulkarni is presently serving as the president of JNCASR, Bangalore since 2020. His research focus includes application of chemistry to high-end device research by formulating new strategies in synthesis of nanomaterials, nanopatterning and nanodevice fabrication including molecular systems. He has published more than 325 papers and has obtained 25 patents. He is the recipient of several awards and recognition which includes Fellow of National Academy of Sciences, Allahabad; Indian Academy of Sciences, Bangalore; Asia Pacific Academy of Materials; Indian National Science Academy; Indian National Academy of Engineering; Fellow of J.C. Bose; Fellowship of the Royal Society of Chemistry etc.