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The roles of nanomaterials in electrical communication, neural connection and brain function of biosystems

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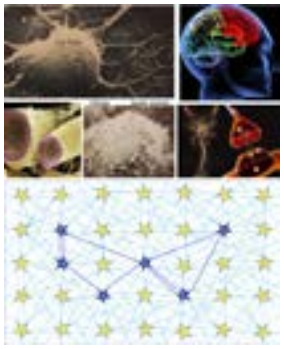
Electrical and chemical communication exists extensively among cells of both animals and plants. We reviewed the roles of several natural nanomaterials, such as phosphorous lipid bilayers, protein ion channels, connecting proteins, vesicles of neurotransmitters, in neural functions and brain functions at the cell and system levels. Membranes serve as the dielectric isolation layers for a transmembrane ion concentration gradient, and as the frameworks in electrolyte-membrane-electrolyte waveguides for transmission of pulsed electromagnetic waves [1,2]. Proteins serve as sources for generation of electromagnetic pulsed waves. Nano-sensors turn heat, pressure, sounds, smells and photon interactions into electrical signals. Neurotransmitters and connection proteins help chemical synapses turn into electrical synapses, and thus may form strongly connected 2D and/or 3D neurosome networks as data codes for memory and brain functions [3-5]. In this wonderful nano-bio-world, many questions remain open to date.



From top left to bottom right: SEM photo of a neuron cell; A carton of a brain; A SEM image of two myelinated axons; A SEM image of a neurosome that is connected with tens of synapses; A carton of a chemical synapse; illustration for a strongly connected 2D network of neurosomes, which serves as a 2D code for memory process in a brain.

Biography

Shengyong Xu obtained his Ph.D. degree in 1999 from National University of Singapore, worked there in 1999-2001, and at Pennsylvania State University in 2001-2006. Since 2006 he has been working at Peking University on the underlying physics of electrical communication in biosystems, including soft-material electromagnetic (EM) waveguides, propagation of EM pulses in axons and among cells, working mechanism of brain, etc. His group also work on time-resolved 2D mapping of temperature distribution for micro-devices and single cells.

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