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## Natural Organic Honey-CNT Memristor Based Artificial Synaptic Devices for Sustainable Neuromorphic System

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Z. Templin and F. Zhao (Washington State University)

### Abstract Text:

Neuromorphic computing is considered to have the potential to overcome the limitations of traditional von Neumann architecture due to its high efficiency, low energy consumption, and fault-tolerance. Hardware components that can emulate the synaptic plasticity of neurons, i.e. artificial synaptic devices, are required by neuromorphic systems. New devices have been examined for such components, such as phase-change artificial synapse, ferroelectric artificial synapse, and memristor synapses. Among them, memristor, a two-terminal metal-insulator-metal structure that are analogous to a biological synapse with presynaptic neuron (top electrode), postsynaptic neuron (bottom electrode), and synaptic cleft (memristive film), is a promising device technology because of its tunable resistance, scalability, 3D integration compatibility, low power consumption, and relatively high speed. In contrary to inorganic materials such as metal oxides, natural organic materials have attracted interest to form the memristive layer because they are renewable, biodegradable, sustainable, biocompatible, and environmentally friendly. In this paper, honey solution embedded with carbon nanotubes (CNTs) was processed into the memristive layer by a low cost solution-based process, with synaptic plasticity of the final honey-CNT memristors characterized, including forget and relearn, spike-rate-dependent plasticity, spike-voltage-dependent plasticity, short-term to long-term memory transition, paired pulse facilitation, and spatial supra-linear summation behaviors. The successful emulation of these essential biological synaptic behaviors demonstrates the potential of honey-CNT memristors as a viable hardware component in neuromorphic computing systems.

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### Submitter's E-mail Address:

feng.zhao@wsu.edu

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First Author

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Zoe Templin

**Affiliation(s):** Washington State University

**Phone Number:**

**E-mail Address:** zoe.templin@wsu.edu

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Second Corresponding Author

Professor Feng Zhao

**Affiliation(s):** Washington State University

**Address:**

14204 NE Salmon Creek Ave

Vancouver, WA, 98686

USA

**Phone Number:** 3605469187

**E-mail Address:** feng.zhao@wsu.edu