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NEWS | FEBRUARY 06 2023

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Scilight 2023, 061101 (2023)
https://doi.org/10.1063/10.0017230

AIP Publishing

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6 February 2023

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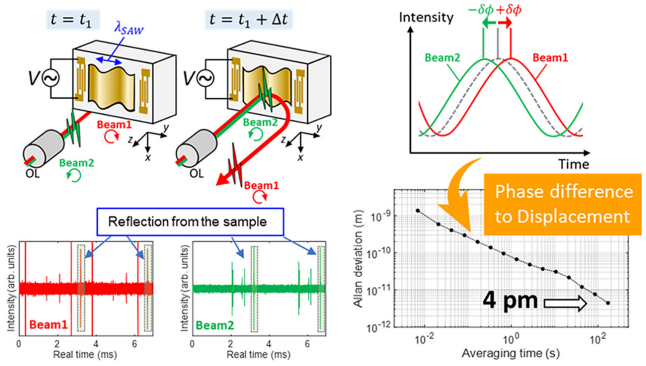
Artificial intelligence takes a step forward in reconfigurable, 2D ferroelectric devices.



Inspired by the human brain, neuromorphic computing has been researched extensively to meet the requirements of a data-explosive era. Dense neural networks within the brain enable parallel operations of information processing, memorizing, and learning. While significant breakthroughs in artificial intelligence over recent years have resulted in man-made synaptic and neuronal devices, latency and low power efficiency are still issues.

The development of a neural network in hardware with constrained power and chip area is necessary to obtain comparable capabilities of a human brain. Zhai et al. designed a ferroelectric semiconductor field-effect transistor device which includes neuronal and synaptic functions. Based on room temperature out-of-plane and in-plane dual polarization effects, using 2D In_2Se_3 materials for the channels, the device mimics neural behavior.

“This reconfigurable device can switch from continuously modulated conductance with nonvolatility for emulating synapses to spiking behavior with volatility for mimicking neurons,” said Su-Ting Han.

It can be used not only in static neural networks, but also in self-adaptive dynamic neural networks.

During the static neural network simulation, the researchers obtained accuracy rates of nearly 72% for expression classification and over 95% for face recognition. The dynamic recognition rate for digital images was nearly 85%, exhibiting a more powerful learning ability and efficiency than the static neural network.

“Our work proves the effectiveness of the reconfiguration method,” said Han. “Furthermore, the ability to design the building blocks on demand opens up new directions for brain-like computers.”

Source: “Reconfigurable 2D-ferroelectric platform for neuromorphic computing,” by Yongbiao Zhai, Peng Xie, Jiahui Hu, Xue Chen, Zihao Feng, Ziyu Lv, Guanglong Ding, Kui Zhou, Ye Zhou, and Su-Ting Han, *Applied Physics Reviews* (2023). The article can be accessed at https://doi.org/10.1063/5.0131838.