IN-MEMORY COMPUTING

IGZO and RRAM team up

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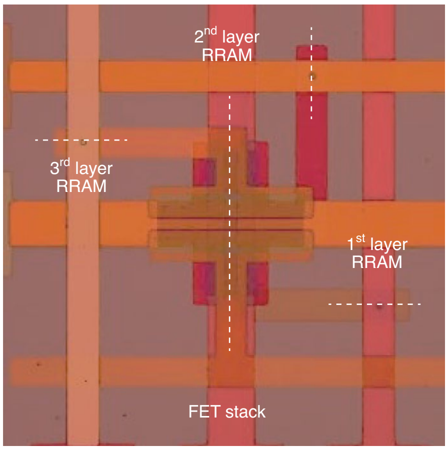

Credit: IEEE

Artificial neural networks (ANN) can process large amounts of data in parallel and play a key role in a range of artificial intelligence applications. In-memory computing using resistive random-access memory (RRAM) and silicon access transistors (1T1R) offers one method to implement artificial neural network models in hardware. However, building area-efficient monolithic chips that contain multiple stacked layers of memory and silicon transistor devices remains challenging due to the thermal limitations associated with silicon processing. Jixuan Wu and colleagues at the University of Tokyo have now overcome these constraints by using indium gallium zinc oxide (IGZO) as the channel material in the access transistors.

The researchers fabricated a four-layer 1T1R RRAM array, where each layer is rotated 90° to keep interconnect wiring to a minimum. By using IGZO as the transistor channel material, processing temperatures throughout the fabrication could be kept below 400 °C. This ensured that as each new layer of IGZO transistor was added it did not thermally impact the underlying layer, which was confirmed with layer-by-layer device characterisation. In-memory XNOR logic operation using a voltage sensing scheme was demonstrated using a pair of 1T1R cells and a comparator. The performance of the RRAM-based XNOR was assessed for use in a three-layer binary neural network with an estimated accuracy of around 79% and bit error rate of 10^{-7} when using the MNIST dataset.

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