Abstract

Memristive Materials and Devices for Neuromorphic Computing

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Memristive devices[1] have become a promising candidate to enable efficient computing[2] for the big data and IoT era[3]. Such computing can be implemented on a Resistive Neural Network[4] with memristive synapses[5] and neurons[6] or a Capacitive Neural Network[7,8] with memcapacitive synapses and neurons. I will first briefly introduce the promises and challenges of memristive materials and devices for such applications and then discuss examples with different levels of bio-inspiration: first, deep learning accelerators[9] with supervised online learning[10]; second, neuromorphic computing for pattern classification with unsupervised learning[6]; last, other computing applications, such as reinforcement learning[11] for decision making, artificial nociceptors for robotics[12], provable key destruction[13] and true random number generators14 for cybersecurity.

1 Nature Nanotechnology **8**, 13 (2013)
2 Nature materials **18**, 309 (2019)
3 Nature Reviews Materials **5**, 173 (2020)
4 Nature Machine Intelligence **1**, 434 (2019)
5 Nature Materials **16**, 101 (2017)
6 Nature Electronics **1**, 137 (2018)
7 Nature Communications **9**, 3208 (2018)
8 Nature Machine Intelligence **1**, 49 (2019)
9 Nature Electronics **1**, 52 (2018)
10 Nature communications **9**, 2385 (2018)
11 Nature Electronics **2**, 115 (2019)
12 Nature communications **9**, 417 (2018)
13 Nature Electronics **1**, 548 (2018)
14 Nature communications **8**, 882 (2017)