Efficient Data Processing Using Tunable Entropy-stabilized Oxide Memristors

S. Yoo, S. Chae, T. Chiang, M. Webb, T. Ma, H. Paik, Y. Park, L. Williams
K. Nomoto, H.G. Xing, S. Trolier-McKinstry, E. Kioupakis, J.T. Heron, W.D. Lu

Memristive devices are of potential use in a range of computing applications. However, many of these devices are based on amorphous materials, where systematic control of the switching dynamics is challenging. Here we report tunable and stable memristors based on an entropy-stabilized oxide. We use single-crystalline (Mg,Co,Ni,Cu,Zn)O films grown on an epitaxial bottom electrode. By adjusting the magnesium composition (XMg = 0.11-0.27) of the entropy-stabilized oxide films, a range of internal time constants (159-278 ns) for the switching process can be obtained. We use the memristors to create a reservoir computing network that classifies time-series input data and show that the reservoir computing system, which has tunable reservoirs, offers better classification accuracy and energy efficiency than previous reservoir system implementations.

Tunable and stable memristors based on single-crystalline entropy-stabilized oxide films grown on epitaxial bottom electrodes can be used to create energy-efficient reservoir computing networks.