MEMRISTIVE DEVICES FOR COMPUTING

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Abstract:

Existing technologies for the current computing system are approaching their physical limits, and novel device concepts are required as device sizes continuously decrease. Under these new concepts, the devices need to be not only increasingly infinitesimal and simple but also increasingly capable. Memristive devices (also called RRAM when used for memory) seem to fulfill these goals well for the next generation computing system. These devices are electrical resistance switches that can retain a state of internal resistance based on the history of applied voltage or current. Memristive devices can store and process information, and offer several key performance characteristics that exceed conventional integrated circuit technology [1]. An important class of these devices is two-terminal resistance switches based on ionic motion, which are built from a simple conductor/insulator/conductor thin-film stack. The switching mechanisms[2,3] of metal-oxide switches will be briefly introduced first, followed by a related family of nanodevices[4] along with their potential applications[5,6]. Then the promises and challenges[1,7] with respect to using these devices will be discussed together with some possible solutions to the challenges[8-12].

1 J. J. Yang et al., Nature Nanotech. **8,** 13 (2013).
2 J. J. Yang et al., Nature Nanotech. **3,** 429 (2008).
3 F. Miao et al., Adv. Mater. **23,** 5633 (2011).
4 J. J. Yang et al., Adv. Mater. **21,** 3754 (2009).
5 J. Borghetti et al., Nature **464,** 873 (2010).
6 Q. F. Xia et al., Nano Lett. **9,** 3640 (2009).
7 J. J. Yang et al., MRS Bulletin **37,** 131 (2012).
8 J. J. Yang et al., Nanotechnology **20,** 215201 (2009).
9 J. J. Yang et al., Appl. Phys. Lett. **97,** 232102 (2010).
10 J. J. Yang et al., Appl. Phys. Lett. **100,** 113501 (2012).
11 J. J. Yang et al., Adv. Mater. **22,** 4034 (2010).
12 B. J. Choi et al., Nano Lett. **13,** 3213 (2013).

Briefbio:

Dr. Jianhua (Joshua) Yang is principal research scientist at HP Labs, leading memristive device study. His current research interests are Nanoelectronics and Nanoionics, especially for memory and computing applications, where he authored and co-authored over 70 papers in peer-reviewed academic journals, and holds 32 granted and over 70 pending US Patents. He serves as a co-Editor of Applied physic A. He was the chair of the 8th IEEE Nanotechnology Symposium on "Emerging Non-volatile Memory Technologies". He obtained his B.A. degree in mechanical engineering from Southeast University in China and PhD from the University of Wisconsin – Madison in Material Science Program in 2007.