Memristors with thousands of conductance levels for analog computing

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Abstract:

The analog data deluge issue nowadays call for multipurpose analog computing platforms with great reconfigurability and efficiency, namely, field-programmable analog arrays (FPAAs).[1] FPAAs as the analog counterpart of field-programmable digital arrays (FPGAs) open opportunities for fast prototyping analog designs as well as efficient analog signal processing and neuromorphic computing. Memristors may be the ideal building blocks for FPAAs if they are truly analog with many conductance levels, not just for lab-made devices, but more importantly, devices fabricated in foundries. We have recently demonstrated 2048 conductance levels, a record among all types of memories, achieved with memristors in fully integrated chips with 256 256 memristor arrays monolithically integrated on CMOS circuits in a standard foundry.[2] We have unearthed the underlying physics that previously limited the number of distinguishable conductance levels in memristors and developed electrical operation protocols to circumvent such limitations. These results reveal insights into the fundamental understanding of the microscopic picture of memristive switching and provide approaches to enable high-precision memristors for various applications.

Reference:

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