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Ferroelectric-gate Field Effect Transistor Based Nonvolatile Memory Devices Using Silicon Nanowire Conducting Channel

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Ferroelectric-gate field effect transistor based memory using a nanowire as a conducting channel offers exceptional advantages over conventional memory devices, like small cell size, low-voltage operation, low power consumption, fast programming/erase speed and non-volatility. We successfully fabricated ferroelectric nonvolatile memory devices using both n-type and p-type Si nanowires coated with organic ferroelectric poly(vinylidene fluoride-trifluoroethylene) [P(VDF-TrFE)] via a low temperature fabrication process. The devices performance was carefully characterized in terms of their electrical transport, retention time and endurance test. Our p-type Si NW ferroelectric memory devices exhibit excellent memory characteristics with a large modulation in channel conductance between ON and OFF states exceeding 10^5; long retention time of over $5x10^4$ sec and high endurance of over 105 programming cycles while maintaining ON/OFF ratio higher 10^3. This result offers a viable way to fabricate a high performance high-density nonvolatile memory device using a low temperature fabrication processing technique, which makes it suitable for flexible electronics.

Keywords: Ferroelectric-gate field effect transistor, P-type Si, Nonvolatile memory