Abstract Submitted
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Non-volatile spin bistability based on ferromagnet-semiconductor quantum dot hybrid nanostructure[1] YURIY SEMENOV, HANI ENAYA, North Carolina State University, JOHN ZAVADA, U.S. Army Research Office, KI WOOK KIM, North Carolina State University — Electrical manipulation of a memory cell based on bistability effect in a nanostructure consisting of a semiconductor quantum dot (QD) adjoining on opposite sides with a dielectric ferromagnetic layer (DFL) and a reservoir of itinerant holes is investigated theoretically. The operating principle is based on the interplay between the exchange field of the holes $\mathbf{B}_h$ acting on the magnetization vector of the DFL $\mathbf{M}$ perpendicular to structure plane and the anisotropy field $\mathbf{B}_a$ which aligns $\mathbf{M}$ along the plane. At low hole population of the QD ($B_h << B_a$), $\mathbf{M}$ is still in plane direction (first stable state "0"). If an applied bias populates the QD sufficiently ($B_h > B_a$), the subsequent $\mathbf{M}$ rotation will decrease the hole energy in the QD; hence the high hole population state is sustained (second stable state "1") under a fixed electro-chemical potential set by the reservoir even after bias is removed. The analysis of bit retention time of the proposed memory demonstrates the feasibility of the device with lateral QD size at least 30 nm under room temperature operation. Another advantage is the extremely small dissipative energy for Write/Erase operations.

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