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Spin-gating of a conventional aluminum single electron transistor LIVIU P. ZÂRBO, Institute of Physics ASCR, v.v.i., CZ, CHIARA CICCARELLI, ANDY IRVINE, Microelectronics Group, Cavendish Laboratory, University of Cambridge, UK, JÖRG WUNDERLICH, Hitachi Cambridge Laboratory, Cambridge, UK, RICHARD CHAMPION, BRIAN GALLAGHER, School of Physics and Astronomy, University of Nottingham, UK, TOMÁŠ JUNGWIRTH, Institute of Physics ASCR, v.v.i., CZ, ANDREW FERGUSON, Microelectronics Group, Cavendish Laboratory, University of Cambridge, UK — We report the realization of a single electron transistor in which electron transport from an aluminum source electrode to an aluminum drain electrode via an aluminum island is controlled by spins in a capacitively coupled magnetic gate electrode. The origin of the effect is in the change of the chemical potential on the gate, formed by the ferromagnetic semiconductor GaMnAs, with changing the direction of the magnetization. In agreement with experimental observations, microscopically calculated anisotropies of the chemical potential with respect to the magnetization orientation are of the order of 10μV which is comparable to the electrical gate voltages required to control the on and off state of the single electron transistor. Our phenomenon belongs to the family of anisotropic magnetoresistance effects which can be observed in ohmic, tunneling or other device geometries. In our case, the entire phenomenon is coded in the dependence of the chemical potential on the spin orientation which allowed us to remove the spin functionality from all current contacts and channels and place it in the capacitively coupled gate electrode. Our spintronic device therefore operates without spin current.

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