

# Magneto-logic device using non-magnetic semiconductors at room temperature

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Recently, new type of transistor has been proposed in which electric switching function is manipulated by magnetism instead of electricity. Non-volatile reconfigurable processor is a logic device based on this magnetic switch, promising zero quiescent power and novel functions such as programmable logic operation and non-volatile built-in memory [1].

A simple analytic expression describing operation of avalanche magneto-diode is proposed. The operating mode is classified into high and low conducting states, and they are determined by electric and magnetic field. The proposed expression provides a phase diagram distinguishing these two conducting states. In order to verify our proposal, avalanche magneto-diods were fabricated, and various experimental data were taken from these devices. The theoretical results well simulate the measured data, which can be considered as successful verification of our theoretical model. This model can work as a basic framework for engineering avalanche magneto-diods and for further fundamental research about magnetic-field-dependent impact ionization process. In circuits composed of these switches, logical operations are programmed dynamically by magnetic signals, showing magnetic-field-controlled semiconductor reconfigurable logic at room temperature.

- [1] Sungjung Joo, Taeyueb Kim, Sang Hoon Shin, Ju Young Lim, Jinki Hong, Jin Dong Song, Joonyeon Chang, Hyun-Woo Lee, Kungwon Rhie, Suk Hee Han, Kyung-Ho Shin & Mark Johnson, *Nature* 494, 72-76(2013).