

Spin Insulatronics

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In conventional electronics, the electric charge stores and processes information. In performing these tasks, the electron motion wastes energy by heating the surroundings. This heating prevents the further miniaturization of electronic devices. Spintronics utilizes the electron spin, the electron's magnetic moment, and has caused a revolution in data storage. Nevertheless, electronics and spintronics continue to function by electron transport, which inherently dissipates power due to resistive losses.

Spin insulatronics is profoundly different because there are no moving charges involved, so the power reduction is significant. In magnetic insulators, spin-waves and coherent magnons can strongly couple to electric currents in adjacent conductors. Spin insulatronics is the utilization of this coupling to control electric signals. Spin signals in insulators with extremely low power dissipation may enable superior low-power technologies such as oscillators, logic devices, interconnects, non-volatile random-access memories, and perhaps even quantum information processing.