Thermal nanoelectronics

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Current CMOS integrated circuit development is driven by a lot of innovations, some of its limits are determined by unavoidable physical effects such as tunneling of charge carriers and fluctuations in the number of dopant atoms. The technology has also many difficulties at nanometer scale.

The conventional electronics is based only on electric signal processing. The thermal state of a device may represent information too. At the nanometer scale the heat propagation can be extremely fast, thus thermal computing is an emerging field of investigation.

Our proposed novel active device (phonon transistor = phonsistor) is made up of only bulk type intrinsic domains, consisting of significantly less regions, interfaces (see Fig. 1.).

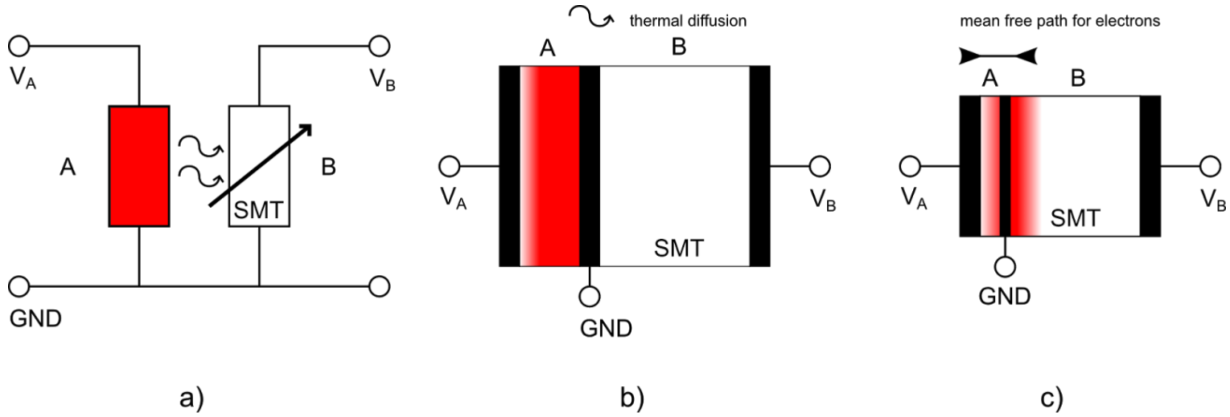

Fig. 1: The phonsistor concept. a) The simplest phonsistor consists of a heating resistor (A) and an SMT resistor (B) thermally coupled. b) Joule heat of the resistor (A) between the left and middle metal electrodes helps switch on the resistor (B) made from MIT material. c) In the case of a scaled down version of the phonsistor hot electrons are injected by ballistic transport directly into the MIT material

The basis of operation is the thermal or hot electron coupling between electron devices containing metal-insulator transition (MIT) material.

Using both the thermal and electrical signals as bit representation may result in advanced IC speed and functionality.