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Volatile Insulator-Metal Transition of VO_2 Resistors as Artificial Neurons ZHEN XU, ZHAOYANG FAN, Texas Tech University — VO_2 exhibits insulator-metal transition when its temperature reaches to ˜68^{o}C, with abrupt resistivity reduction by 4-5 orders of magnitudes. This transition is volatile, and VO_2 will return to its insulator state when its temperature is reduced below the transition temperature. In this work, we show that VO_2 two-terminal thin-film devices (resistors), when driven under electrical pulses, can be used to implement the leaky, integrate and fire function of spiking neurons based on their resistive switching. With given thermal capacity and thermal loss rate, VO_2 devices exhibit firing time and relaxation time between the exciting pulse and the resistance switching. The integrating effect of small pulses can also trigger the insulator to metal transition (firing) from high resistance to low resistance. These characteristics suggest the potential using the volatile phase transition of VO_2 for artificial spiking neurons. We will present our recent experimental results in this aspect. Simulation work based on resistor network will also be discussed, focusing on the dynamic formation of a conducting filament in VO_2 film when driven by a train of small pulses. The simulation confirms the formation of this conducting path in a flashing process during a single pulse of the pulse train when the integrating effect of these pulses arrives the threshold.

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