Electronic Supplementary Material (ESI) for Materials Horizons.

Supporting Information

Ovonic threshold switching-based artificial afferent neurons for thermal in-sensor computing

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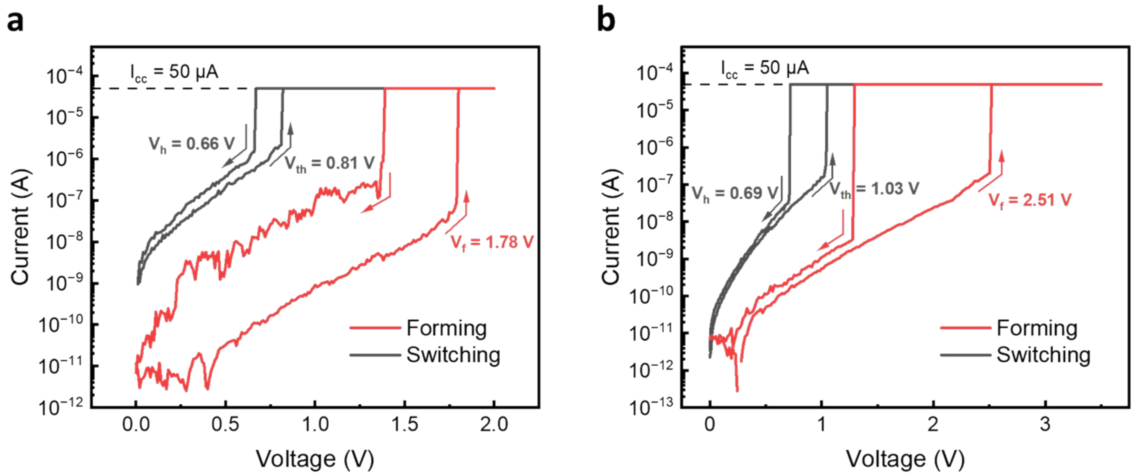

Fig. S1 The DC *I*-*V* sweep of forming and switching for (a) SiTe and (b) N-doped SiTe devices.

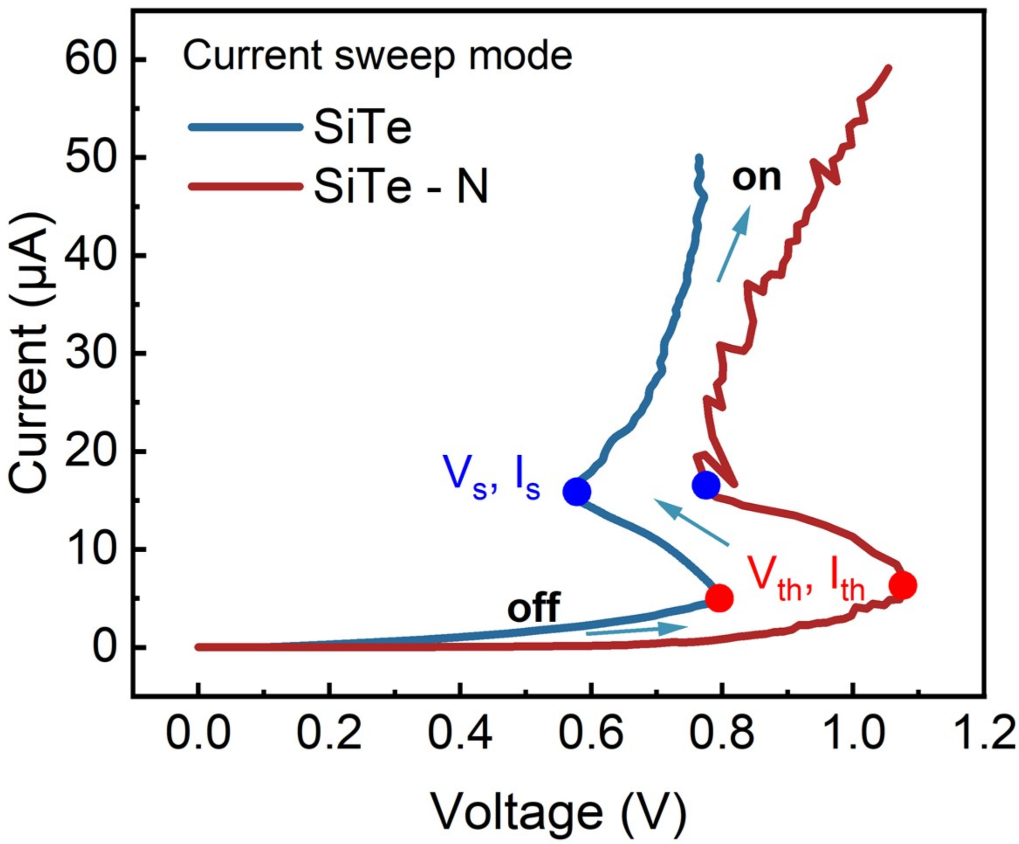

Fig. S2 The current-controlled *I-V* characteristics of SiTe and N-doped SiTe devices. Red and blue closed circles denote the threshold points and "snap-back" points, respectively. S-shaped negative differential resistance (NDR) is observed in both devices. In the voltage sweep mode, a compliance current (CC) is always set to protect the devices and maintain the volatile properties. Unlike voltage sweep, the current sweep mode can readily visualize the voltage and current status of the OTS devices immediately after threshold switching. It can be found that N-doped SiTe device exhibits lower leakage current and larger threshold voltage than SiTe device. When I_{th} is reached, the devices resistance decrease abruptly and exhibit characteristic NDR. The devices then are turned on at the "snap-back" points, the starting point of the ON state.

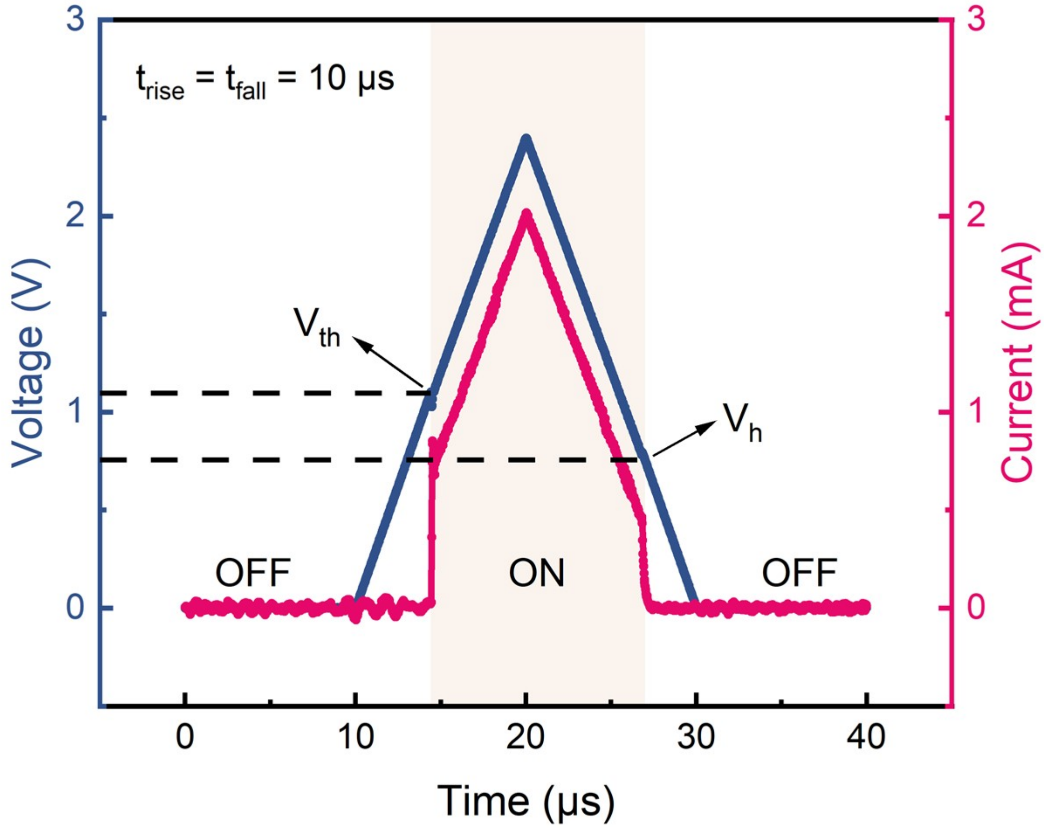

Fig. S3 Dynamical transient response of the N-doped SiTe OTS device under the triangular voltage pulse with a 2.5 V amplitude and 10 μs rising/falling edges. V_{th} and V_h are extracted from the switch between the ON state and OFF state. The blue line represents the voltage signal applied on the device, and the pink line represents the acquired current signal.

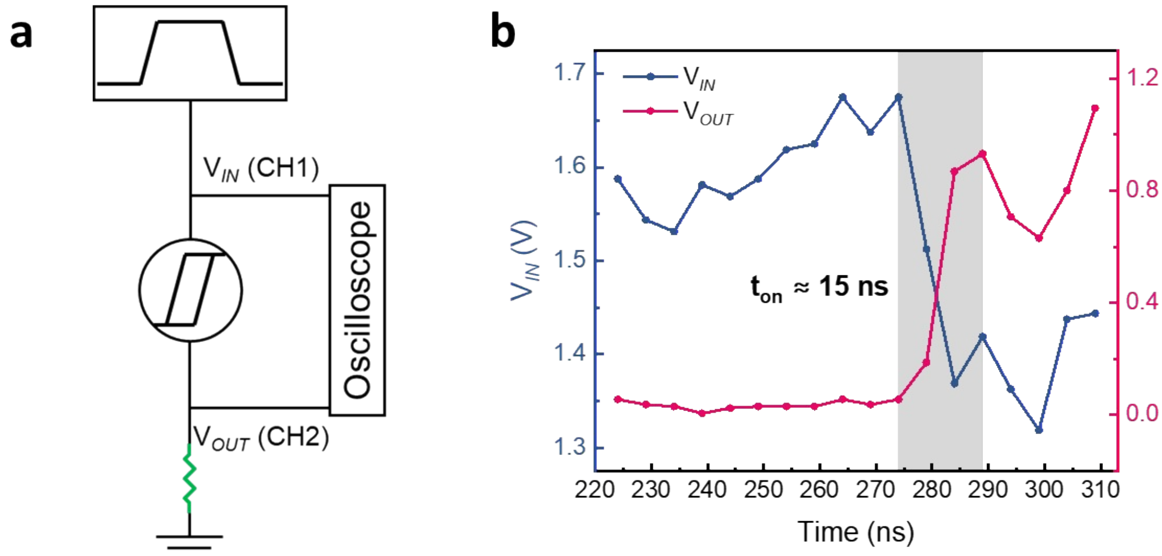

Fig. S4 (a) The schematic switching speed test circuit of the OTS device. (b) Enlarged view of ON switching curves, the N-doped SiTe OTS device is turned on within ~15 ns at a voltage of 1.68 V.

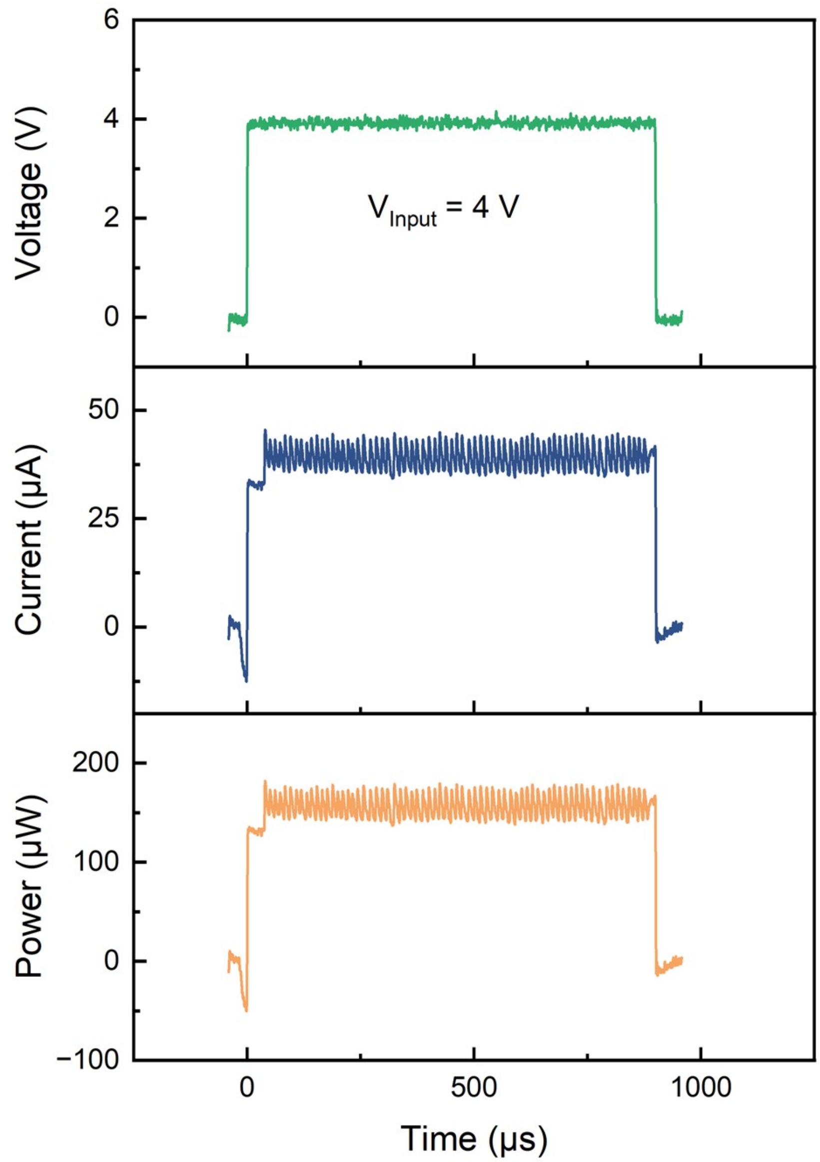

Fig. S5 The energy consumption of artificial thermal afferent neurons based on N-doped SiTe OTS at 25 °C. The transient power is calculated by multiplying the input voltage by the output current, and the energy consumption for each spike is determined by dividing the total energy consumption by the number of spikes within a period of time.

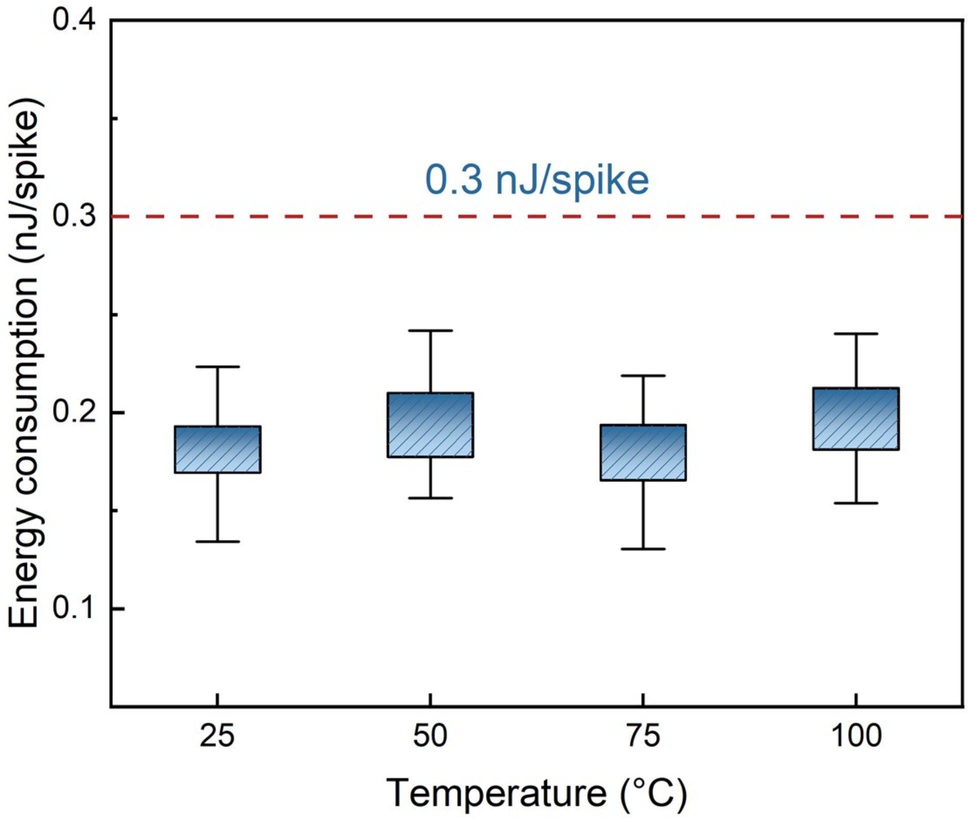

Fig. S6 The corresponding calculated energy consumption *versus* temperature. Five sets of energy consumption were measured for each temperature.

Table S1. Comparison of artificial afferent neurons based on different materials.

Devices	**Materials**	**Leakage current (μA)**	**Threshold Voltage (V)**	**Energy consumption (nJ/spike)**	**Additional sensor**	**Reference**
Metal-insulator transition	VO_2	300	1.35	2.9	Required	[1]
	NbO_x	~100	-1.42	~6	Required	[2]
	NbO_x	10-100	-1.65	N.A.	Required	[3]
Ovonic threshold switching	N-doped SiTe	5.5×10^{-3}	1.03	< 0.3	Not required	This work

References

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