Supplementary Materials: Modeling and Analysis of a Radiative Thermal Memristor

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1. Performance of the radiative thermal memristor

1.1. Thermal conductance Curve

The plot depicted in Figure S1 illustrates the relationship between Thermal Conductance (G) and Temperature Difference (ΔT) across various values of θ. This visual representation effectively demonstrates how changes in the parameter θ influence the width of the curves in the plot. In other words, the variations in θ play a crucial role in determining the spread of the plotted curves, which decreases as θ decreases.

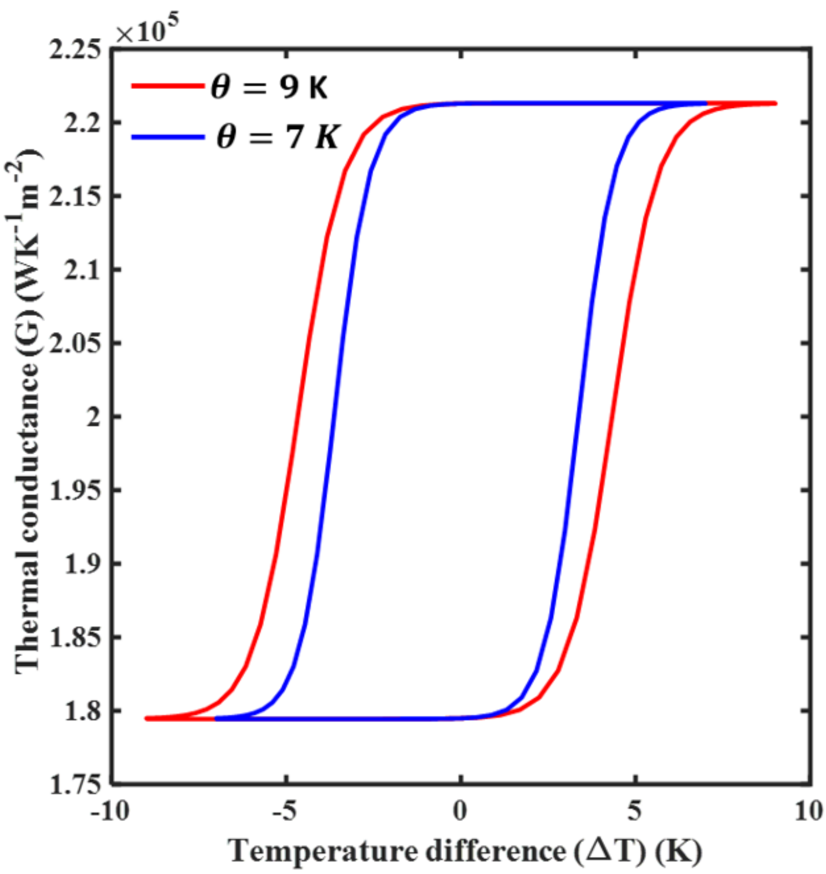

Figure S1. Closed loops of thermal conductance against temperature difference (ΔT) at different values of θ

1.2. Determination of the constant (α)

The value of α is calculated as follows: In the linear segment of the Lissajous curve, the heat flux (Q) is directly proportional to the temperature difference (ΔT), expressed as $Q \propto \Delta \mathrm{T}$. As outlined in the main manuscript, this relationship can be represented as $Q = G\Delta \mathrm{T}$, where G denotes the slope of the linear portion of the zero crossing.

The expression for G is given by:

$$G = \frac{\alpha k_{m(i)} T_{av}}{d} \tag{1}$$

$$\alpha = \frac{G \cdot d}{k_m T_{av}} \tag{2}$$

Where:

- $k_m = 5.3\,\mathrm{Wm^{-1}K^{-1}}$
- $k_i = 3.4\,\mathrm{Wm^{-1}K^{-1}}$
- $d = 10\mu m$
- $T_{av} = 305.5\,\mathrm{K}$
- $G \approx 0.22\,\mathrm{MWm^{-2}K^{-1}}$

By substituting these parameters into Equation 2, we can determine the value of α. Thus, we have:

$$\alpha = \frac{G \cdot d}{k_m T_{av}} = 0.0013587 \tag{3}$$

2. Code

This excerpt presents a segment of the Mathematica code employed in the context of this study.

$$k(\mathrm{T\_}, \mathrm{T0\_}) := \frac{\mathrm{km} - \mathrm{ki}}{\exp(-\beta(T - \mathrm{T0})) + 1} + \mathrm{ki};$$

$$\mathrm{keffinv}(\mathrm{T\_}, \mathrm{T0\_}) := \frac{1}{k(T, \mathrm{T0})} + \frac{1}{\mathrm{k1}};$$

$$\mathrm{keff}(\mathrm{T\_}, \mathrm{T0\_}) := \frac{1}{\mathrm{keffinv}(T, \mathrm{T0})};$$

$$\Delta\mathrm{T}(\mathrm{t\_}) = \theta \sin(2\pi t);$$

$$\delta\mathrm{T}(\mathrm{t\_}) = \frac{\partial \Delta\mathrm{T}(t)}{\partial t};$$

$$\Delta\mathrm{T1}(\mathrm{t\_}) * = \theta 1 \sin(2\pi t);$$

$$\delta\mathrm{T1}(\mathrm{t\_}) = \frac{\partial \Delta\mathrm{T1}(t)}{\partial t};$$

$$\mathrm{kt}(\mathrm{t\_}) := \begin{cases} k(\mathrm{T0} + \Delta\mathrm{T}(t), \mathrm{T0h}) & \delta\mathrm{T}(t) > 0 \\ k(\mathrm{T0} + \Delta\mathrm{T}(t), \mathrm{T0c}) & \delta\mathrm{T}(t) < 0 \end{cases}$$

$$\mathrm{kteff}(\mathrm{t\_}) := \begin{cases} \mathrm{keff}(\mathrm{T0} + \Delta\mathrm{T}(t), \mathrm{T0h}) & \delta\mathrm{T}(t) > 0 \\ \mathrm{keff}(\mathrm{T0} + \Delta\mathrm{T}(t), \mathrm{T0c}) & \delta\mathrm{T}(t) < 0 \end{cases}$$

$$\mathrm{kteff1}(\mathrm{t\_}) := \begin{cases} \mathrm{keff}(\mathrm{T0} + \Delta\mathrm{T1}(t), \mathrm{T0h}) & \delta\mathrm{T1}(t) > 0 \\ \mathrm{keff}(\mathrm{T0} + \Delta\mathrm{T1}(t), \mathrm{T0c}) & \delta\mathrm{T1}(t) < 0 \end{cases}$$

$$\mathrm{Qeff}(\mathrm{t\_}, \mathrm{d\_}) := \frac{\mathrm{kteff}(t)((\Delta\mathrm{T}(t) + \mathrm{T0}) - \mathrm{T0})}{d};$$

$$\mathrm{Qeff1}(\mathrm{t\_}, \mathrm{d\_}) := \frac{\mathrm{kteff}(t)((\Delta\mathrm{T1}(t) + \mathrm{T0}) - \mathrm{T0})}{d};$$

$$\mathrm{Meff}(\mathrm{t\_}) := \frac{\Delta\mathrm{T}(t)}{\mathrm{Qeff}\left(t, \frac{1}{100000}\right)};$$

$$\mathrm{Meff1}(\mathrm{t\_}) := \frac{\Delta\mathrm{T1}(t)}{\mathrm{Qeff1}\left(t, \frac{1}{100000}\right)};$$

$$\mathrm{ParametricPlot}\left[\begin{pmatrix} \Delta\mathrm{T}(t) & \mathrm{Meff}(t) \\ \Delta\mathrm{T1}(t) & \mathrm{Meff1}(t) \end{pmatrix}, \{t, 0, 1\}, \mathrm{AspectRatio} \to \mathrm{Full}\right]$$