

Supplementary Material for High-performance polymer-based regenerative elastocaloric heat pump.

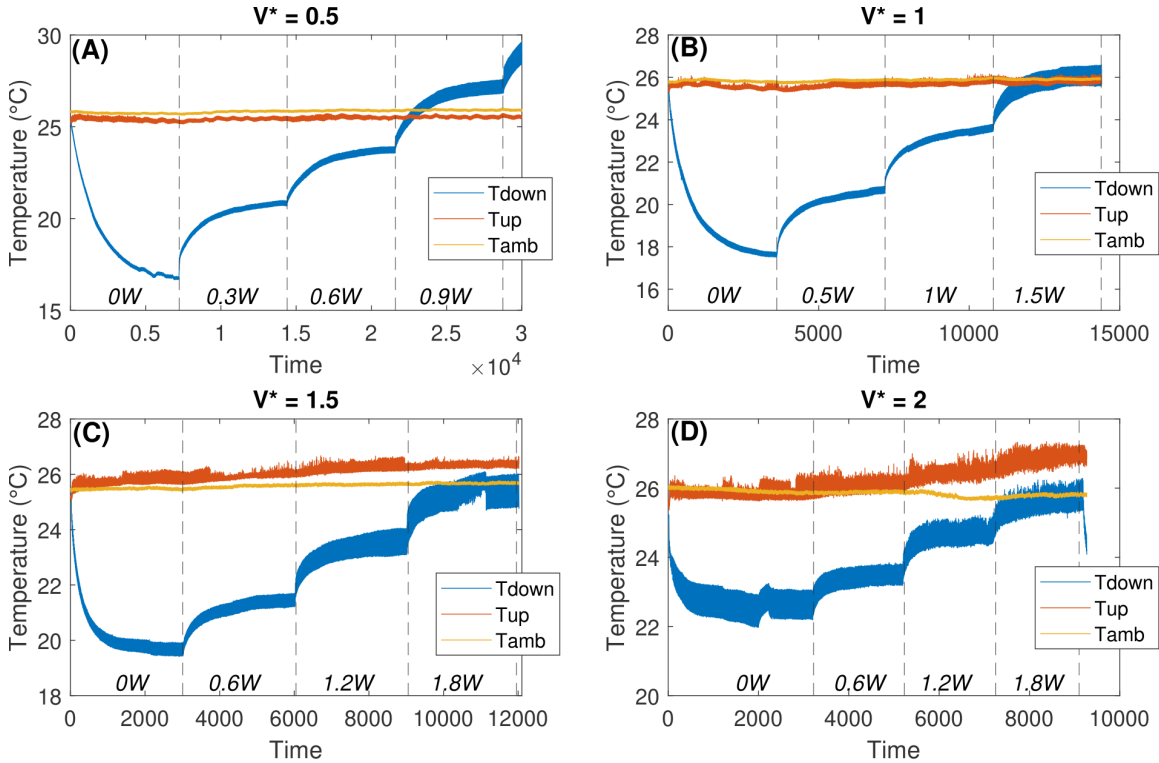


Fig. S1. Device #2 characterization with (A) $V^* = 0.5$, (B) $V^* = 1$, (C) $V^* = 1.5$, and (D) $V^* = 2$ at $f = 0.1$ Hz. Time signals of the measured temperature spans under loaded conditions at different applied powers (indicated in italics): the top reservoir was maintained close to room temperature, whereas the bottom reservoir included the heating source.

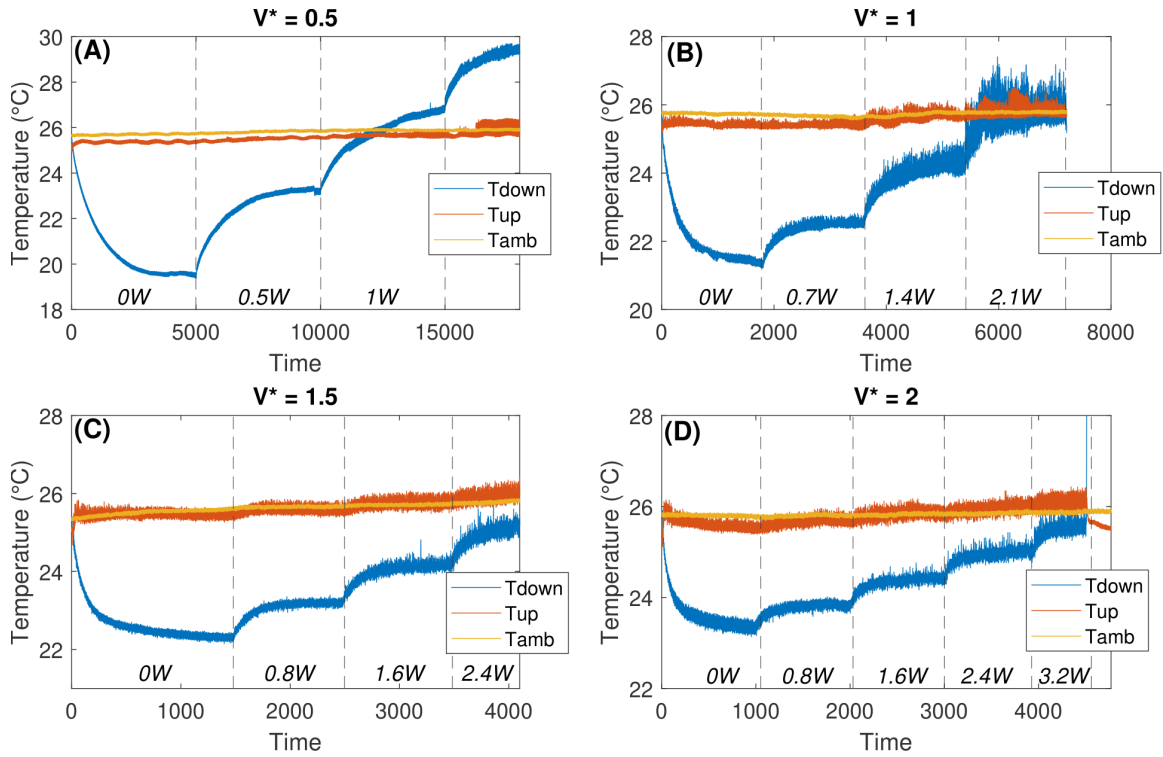


Fig. S2. Device #2 characterization with (A) $V^* = 0.5$, (B) $V^* = 1$, (C) $V^* = 1.5$, and (D) $V^* = 2$ at $f = 0.2$ Hz. Time signals of the measured temperature spans under loaded conditions at different applied powers (indicated in italics): the top reservoir was maintained close to room temperature, whereas the bottom reservoir included the heating source.

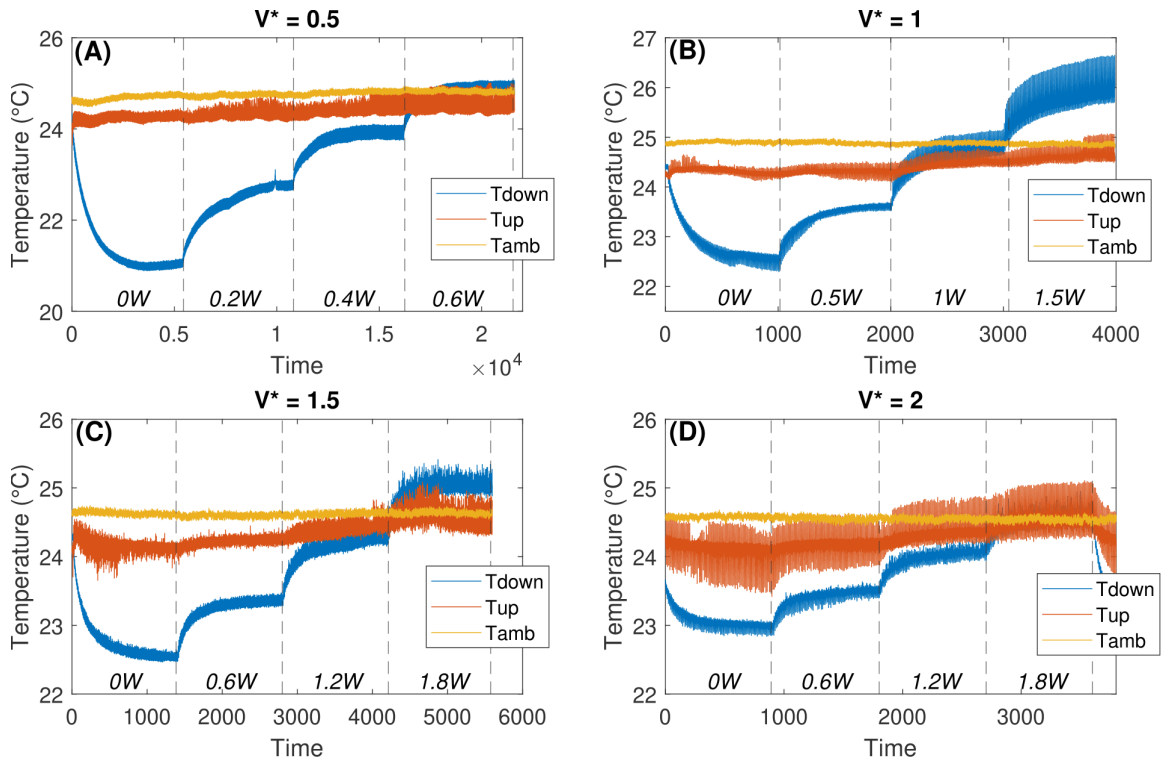


Fig. S3. Device #1 characterization with (A) $V^* = 0.5$, (B) $V^* = 1$, (C) $V^* = 1.5$, and (D) $V^* = 2$ at $f = 0.1$ Hz. Time signals of the measured temperature spans under loaded conditions at different applied powers (indicated in italics): the top reservoir was maintained close to room temperature, whereas the bottom reservoir included the heating source.

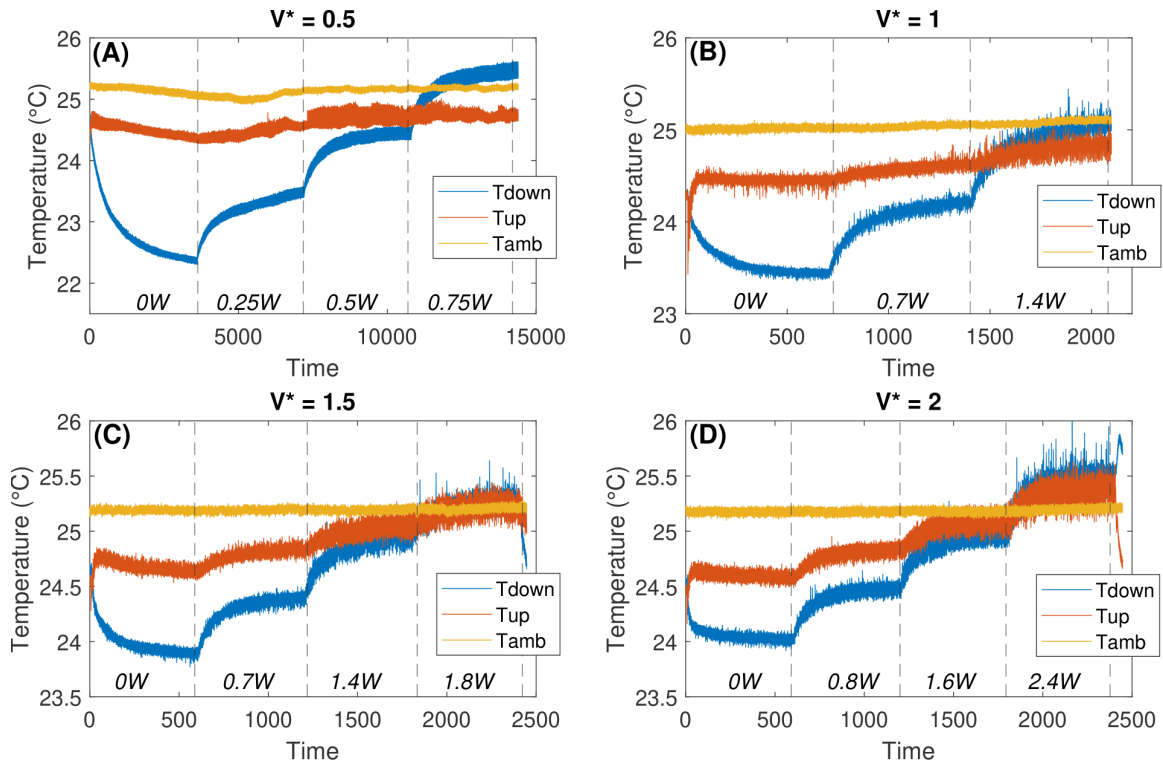


Fig. S4. Device #1 characterization with (A) $V^* = 0.5$, (B) $V^* = 1$, (C) $V^* = 1.5$, and (D) $V^* = 2$ at $f = 0.2$ Hz. Time signals of the measured temperature spans under loaded conditions at different applied powers (indicated in italic): the top reservoir was maintained close to room temperature, whereas the bottom reservoir included the heating source.

Device #2 properties				
Number of tubes	55			
Total mass of rubber tubes (g)	10.6			
Initial internal diameter (mm)	1.59			
Initial external diameter (mm)	3.18			
Fully stretched internal diameter (mm)	0.77			
Fully stretched external diameter (mm)	1.46			
Initial Length (mm)	30			
Fully stretched length (mm)	165			
$\Delta T_{\text{adiabatic}}$ (after 10,000 cycles)	3.4			
Elastocaloric cooling performances of Device #2				
V^*	1			
Total fluid displacement in the tubes (mm)	165			
Cooling power (W)	0	0.52	1.0	1.5
Temperature span (°C)	8.3	5.2	2.4	0
Mechanical losses (W)	0.35	0.31	0.28	0.25
COP	0	1.7	3.6	6
Extrapolated maximum cooling power	1.5 W (142 W/kg)			
Extrapolated maximum temperature span	8.3 K			

Table S1: Properties and experimental results for Device #2 focusing on the case with $V^* = 1$

Device #1 properties				
Number of tubes	19			
Total mass of rubber tubes (g)	4.9			
Initial internal diameter (mm)	3.18			
Initial external diameter (mm)	4.76			
Fully stretched internal diameter (mm)	1.45			
Fully stretched external diameter (mm)	2.05			
Initial Length (mm)	30			
Fully stretched length (mm)	165			
$\Delta T_{\text{adiabatic}}$ (after 10,000 cycles) (°C)	3.6			
Elastocaloric cooling performances of Device #1				
V^*	1			
Total fluid displacement in the tubes (mm)	165			
Cooling power (W)	0	0.5	0.63	1.01
Temperature span (K)	2.4	1.25	0.75	0.05
Mechanical losses (W)	0.15	0.15	0.14	0.14
COP	0	1.99	2.99	4.65
Extrapolated maximum cooling power	1.16 W (232 W/kg)			
Extrapolated maximum temperature span	2.4 K			

Table S2: Properties and experimental results for Device #1 focusing on the case with $V^* = 1$

Movie S1 (separate file). Elastocaloric effect of the rubber tubes of Device #2, after 4000 cycles.

In this video, the surface temperature of the rubber tubes of Device #2 was measured while the tubes were stretched cyclically from an elongation of 3.5–5.5. The temperature value that is displayed corresponds to the instantaneous average of the temperature over the rectangle displayed on the image, and the “STD” value is the standard deviation of the temperature inside the rectangle. Below the infrared image, time plots of the rubber tube length and resulting force are shown.

Movie S2 (separate file). Recording the temperature of the regenerator of Device #2 under no-load condition.

For this video, the thermal insulation was removed to facilitate the surface temperature measurement using infrared imaging. From video time 0 s to 30 s, the video displays the evolution of the temperature for the first three cycles applied from a rest condition. Because of the elastocaloric activity, the temperature of the tubes increases and decreases synchronously with the actuator movement. From the second cycle, a positive temperature gradient is visible (at time $t = 18$ s). From video time 30 s, cycles five to eight are displayed. The temperature gradient is more pronounced. Finally, from video time 1 min, cycles 50 to 53 are shown. The temperature vs. vertical axis is displayed on the right-hand side of the video, corresponding to the temperature along the y-axis, at $x = 0$.