

Supplementary Information

Graphene memristors based on solid-state reduction of graphene oxide

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Effect of bipolar bias sweeps

A typical example of bipolar I-V sweep is given in Fig. R3. The voltage was first swept from 0 to +2.5 V, and to -2.5 V, and then back to 0, with a scan rate of 100 mV/sec. As it can be seen, the current at -2.5 V in every cycle is substantially larger than the current at +2.5 V.

The reduction process is driven by water electrolysis. Hence, upon reversing the polarity of the applied voltage, the role of the electrodes is reversed, and the growth of the rGO dendrite initiates from the electrode. Hence, in a bipolar I-V sweep cycle, rGO dendrites grow from both electrodes.

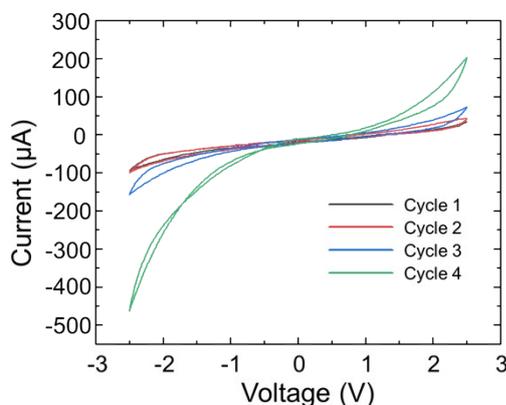


Fig. S1. Reduction of GO at room temperature and constant humidity of 40% using bipolar voltage sweeps.

Effect of ambient humidity

The reduction process was performed at three different humidity levels but at a constant temperature of 23 °C. At higher humidity, the reduction process is quicker because complete reduction happens in fewer number of cycles, as shown in Fig. S1. A humidity-dependent critical cycle number can be defined at which full reduction and transition to the conductive state take place. The critical cycle amounts to 30, 25 and 20 for humidity levels at 30%, 40% and 60%, respectively. This proves that under the same voltage stress conditions, humidity facilitates the reduction of GO

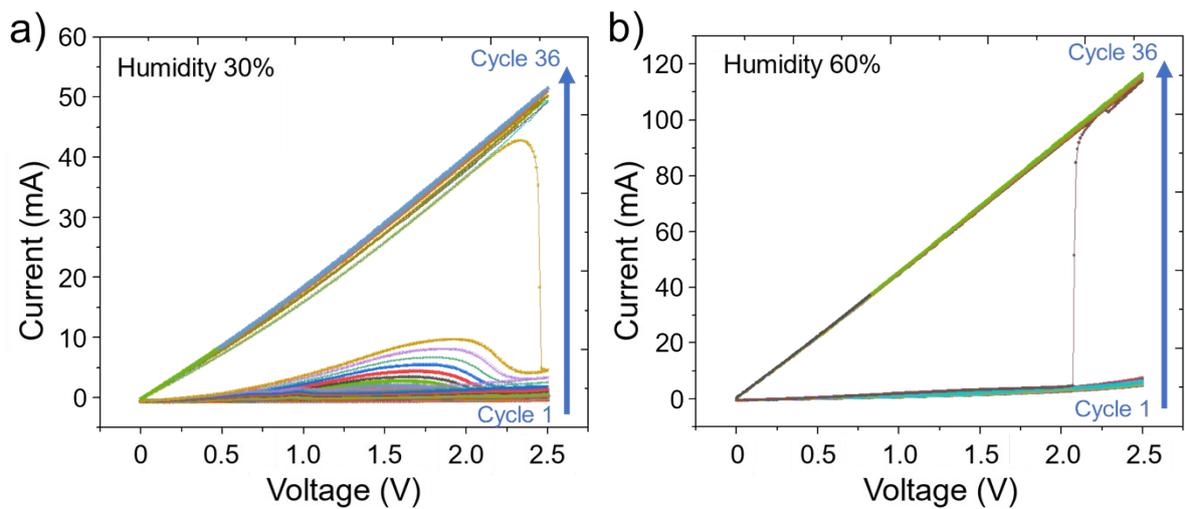


Fig. S2. Reduction of GO at room temperature, under different humidity levels at a) 30% and b) 60%. The results for the humidity level 40% are given in the main manuscript. The scan rate and temperature were 100 mV/s and 21 °C, respectively.

Effect of ambient temperature

The reduction of GO at different temperatures at a constant humidity level (~40%) was performed. These include measurements at room temperature, the results of which are presented in the main text, and at 40 and 70 °C degrees. As shown in Fig. S2, gradual change of conductance also happens at different temperatures, and transition to a conductive state also occurs at both temperatures. The transition occurs at earlier cycles (cycle number 54 at 40 °C vs cycle number 30 at 70 °C). This proves that under the same humidity and voltage stress conditions, temperature also facilitates the reduction of GO.

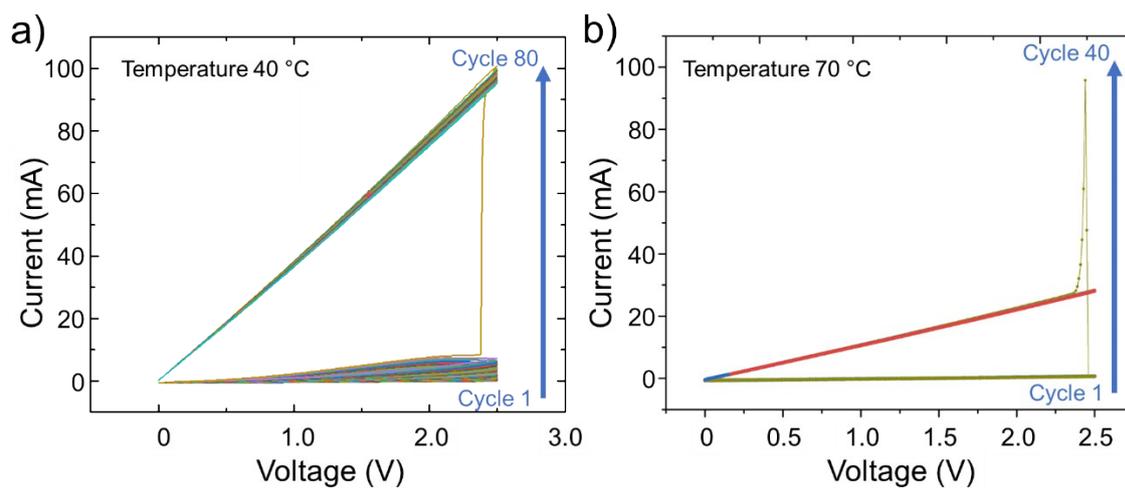


Fig. S3. Reduction of GO at a constant 40% humidity and at different temperatures a) 40 °C and b) 70 °C.