

Supporting Information

Zinc Phthalocyanine Conjugated Cellulose Nanocrystals for Memory Device Applications

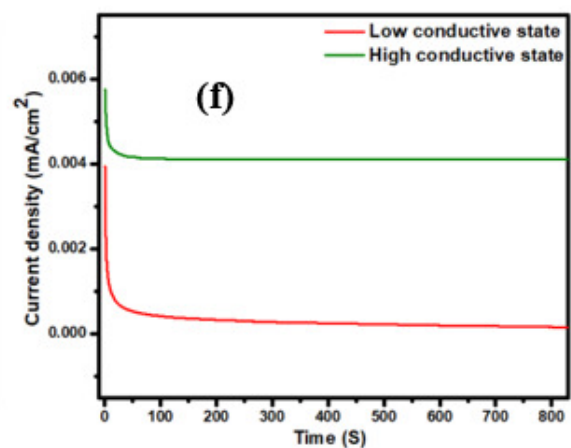
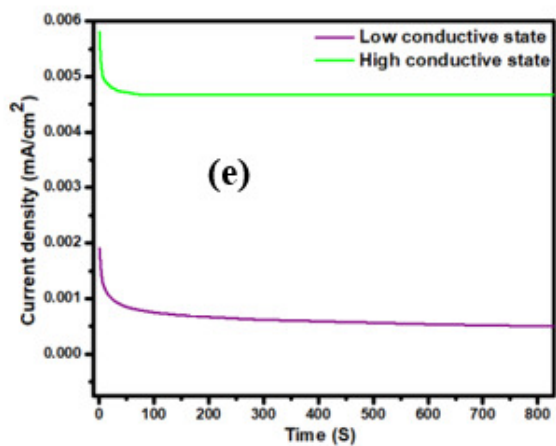
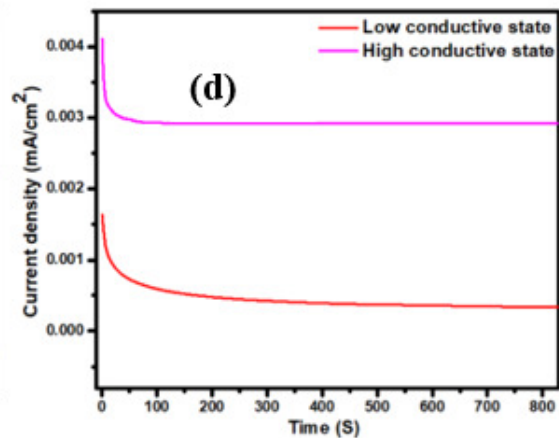
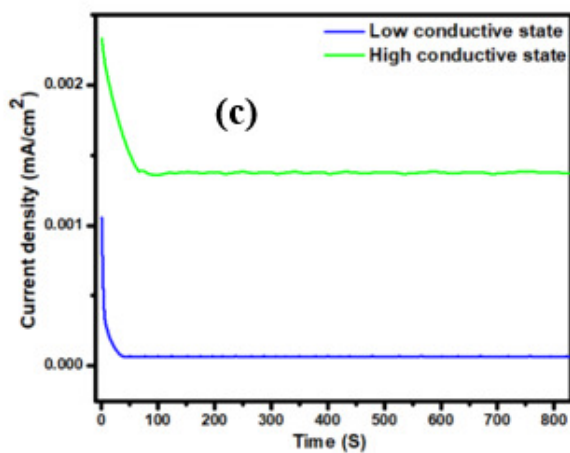
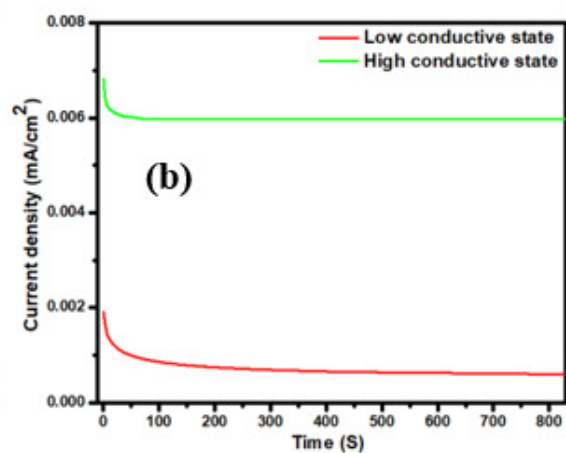
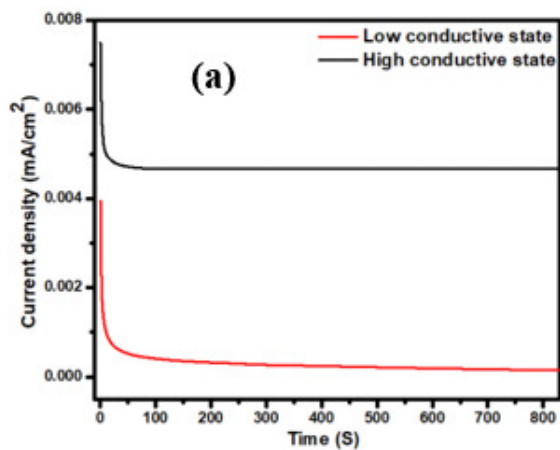
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Reproducibility tests



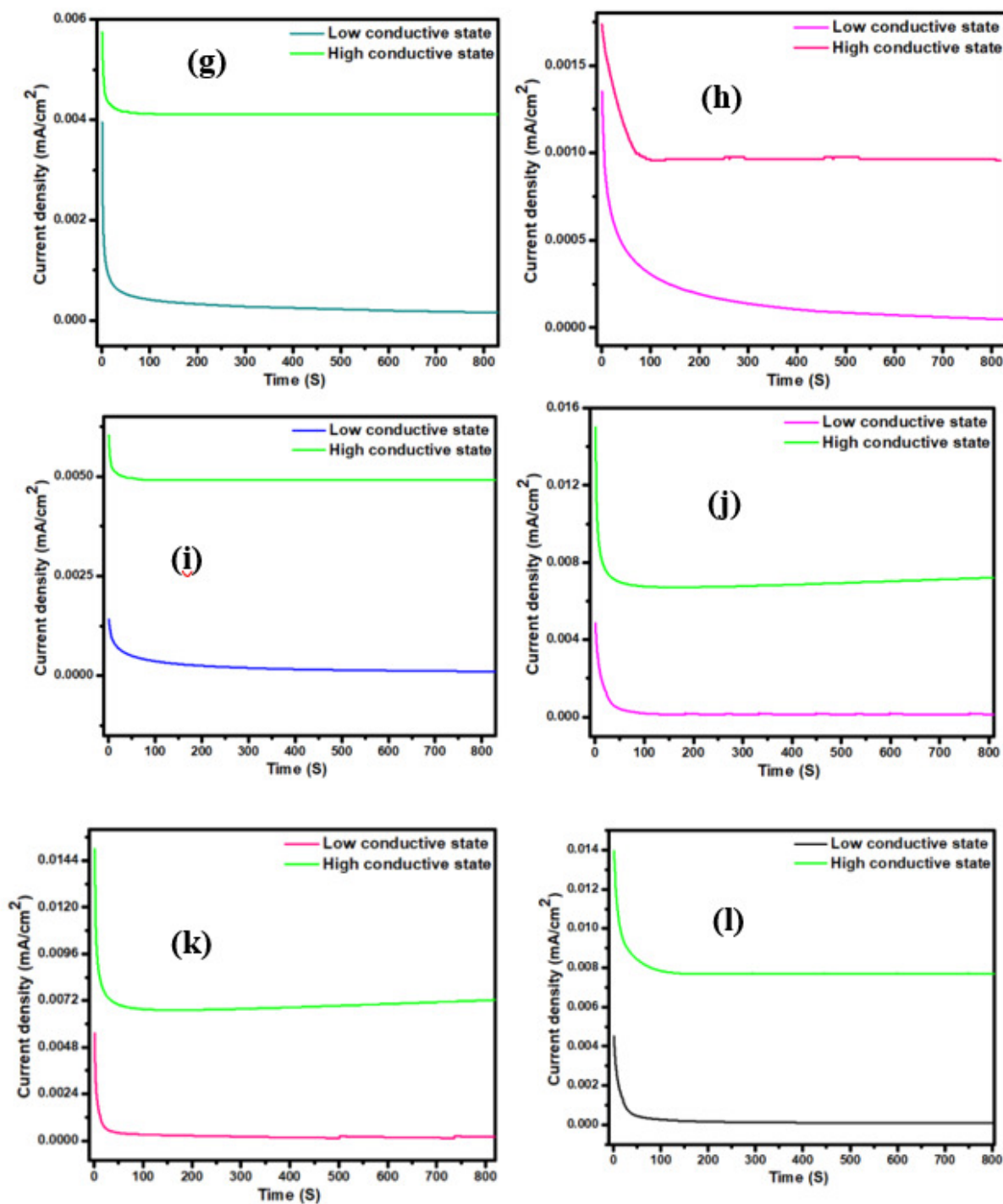
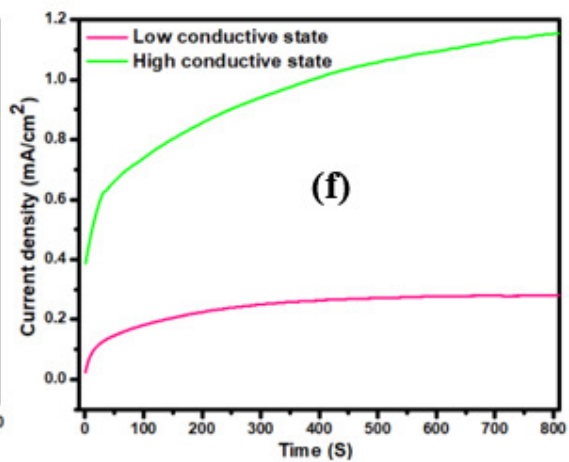
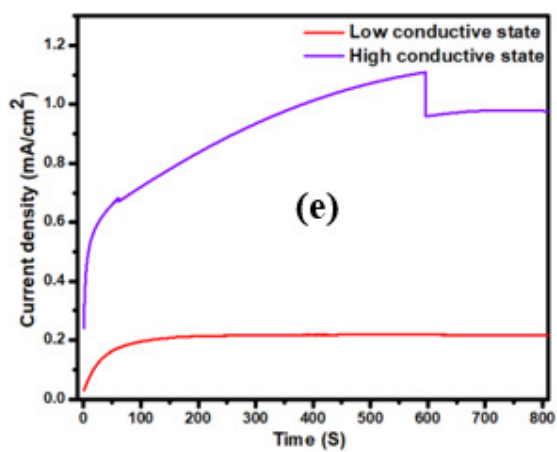
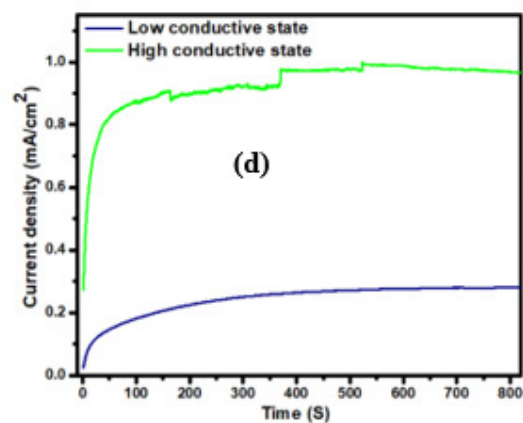
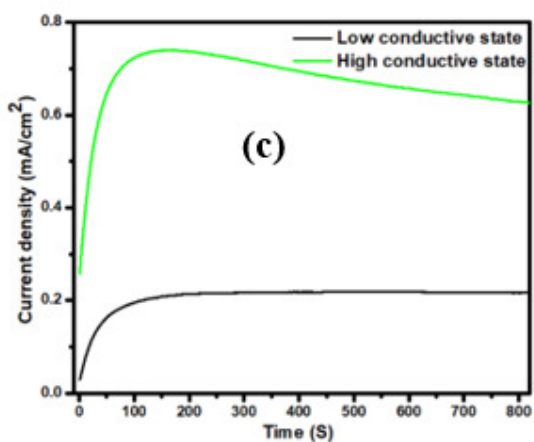
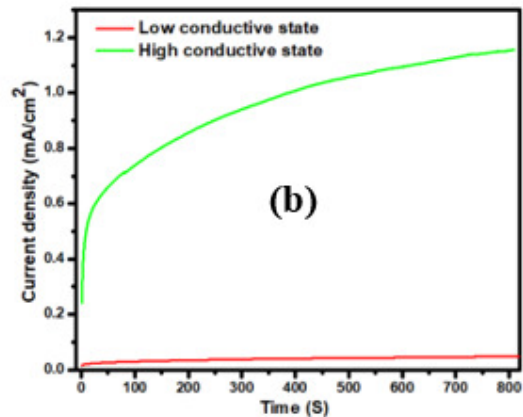
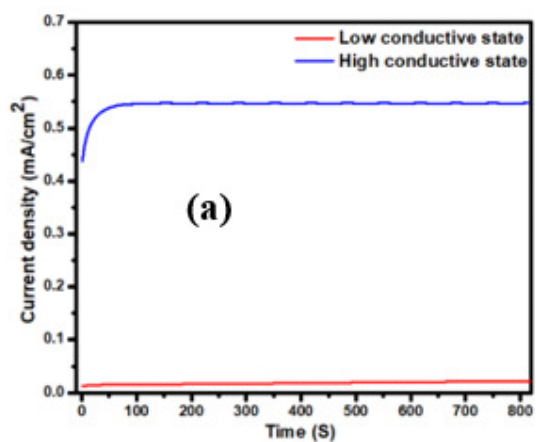


Figure S1. Transient response of ZnPc@Na-CNC based device.

Figure S1 above shows that the basic operation of the zinc phthalocyanine conjugated cellulose nanocrystal thin film memory device is reproducible. Devices (a) through (l) above clearly show the presence of two distinct conductivity states even though there is appreciable dispersion in the magnitudes of the On and Off currents corresponding to those states.



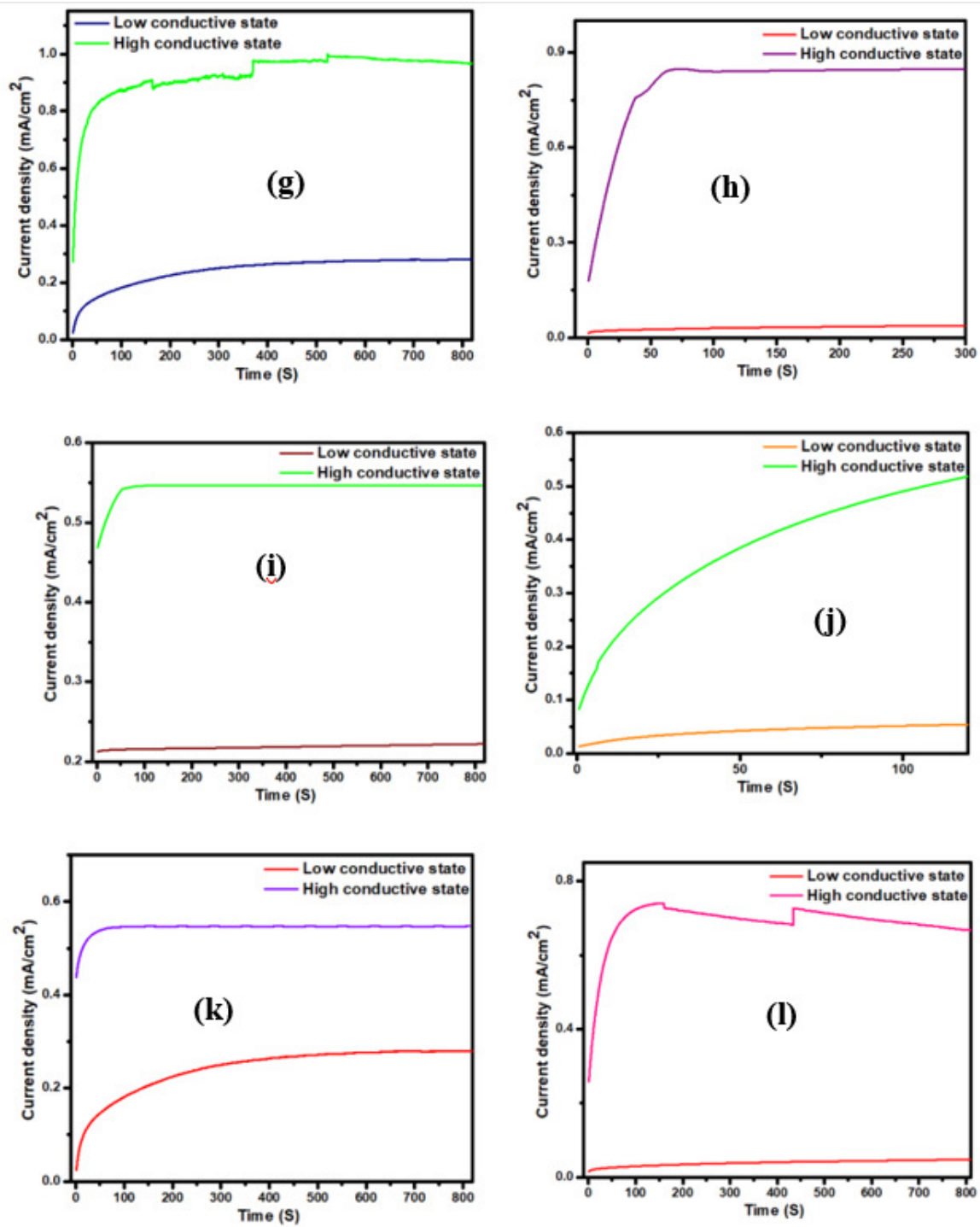


Figure S2. Transient response of bare ZnPc based device.

An environmentally friendly organic memory device

Cellulose nanomaterials emerging from wood have great potential for use in biodegradable nanocomposites for construction [1]. CNCs are biocompatible, non-toxic substances that pose no significant health risks when used in the human body. Similarly, phthalocyanines are low cost, low-toxicity, and earth-abundant chromophores that are widely used to dye textiles worn by human beings. Memory devices fabricated using CNC-conjugated ZnPc organic layer are eco-friendly and can also be used in bioimaging applications [2]. Memory devices fabricated using organic materials also have the potential to reduce costs and increase throughput since the fabrication of organic memory devices uses a low-cost spin-on or dip-coating process to deposit polymer films with active organic materials. The average production cost can be significantly reduced since the bit-cell array can be formed in a single lithographic process rather than several lithographic stages. This introduces the possibility of manufacturing an inexpensive three-dimensional memory structure for wearable electronics, radio frequency identification tags, etc.

References

- [1] D. Klemm, B. Heublein, H. P. Fink, and A. Bohn, "Cellulose: fascinating biopolymer and sustainable raw material," *Angew Chem Int Ed Engl*, vol. 44, no. 22, pp. 3358-93, May 30 2005.
- [2] G. Siqueira, J. Bras, and A. Dufresne, "Cellulosic Bionanocomposites: A Review of Preparation, Properties and Applications," *Polymers*, vol. 2, no. 4, pp. 728-765, 2010.