Dual-mode Switching Electrophoretic Displays with Thermally Reversible Gelators

Ming-Yang Yang, Wen-Jie Hu, Zong Qin and Bo-Ru Yang*

*** State Key Laboratory of Optoelectronic Materials and Technologies, Guangdong Province Key Laboratory of Display Material and Technology, School of Electronics and Information Technology, Sun Yat-Sen University, Guangzhou 510275, People's Republic of China**

***Email: paulyang68@me.com**

An apparent trend in this information age is that the emergence of the Internet of Things (IoT) is changing the world in remarkable ways. Undoubtedly, the evolution of display technology plays a key role in this massive reform. [1] Compared with liquid crystal displays (LCDs) and organic LED displays (OLEDs), electrophoretic displays (EPDs) have the advantages of low power consumption, flexibility and superior outdoor display quality. Therefore, EPDs will perfectly appropriate for many scenarios such as logistics labels, outdoor display boards and wearable devices. However, the ultra-fast response and long-lasting bistability have a difficult time existing with the same electrophoretic panel, greatly restricting the applicability and development of EPDs. [2] To improve the bistability, a higher viscosity is needed to apply a resistance against the gravity in static mode, yet the higher viscosity will hinder the dynamic switching when the particles pass through the cell from one side to the other. Consequently, it's important to distinguish between the static manifestation and dynamic switching for a better display quality. [3]

In this work, we utilized the 12-hydroxystearic acid (HSA) gelator as a core link for dual-mode switching functional EPDs. HSA exhibited mending properties by thermally reversible covalent bond. [4] The gelator-doped electronic ink presented high viscosity due to the crosslinked networks at room temperature, which allowed a good bistability. Furthermore, the networks would spontaneous disruption at a higher temperature to decrease the blocks ahead the particles, which allowed the fast response. By adding the gelator crosslinked by thermally reversible covalent bond, we demonstrated an electrophoretic device with two reversible working modes consisting fast response and good bistability.

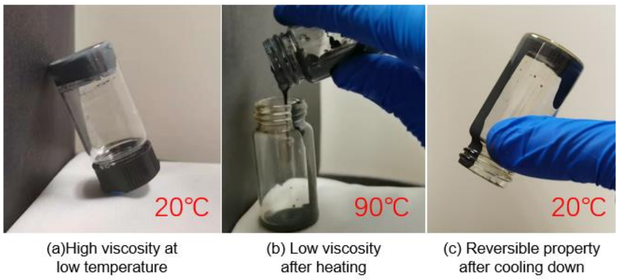


Fig 1. The high viscosity condensation state (a)(c) and low viscosity solution state (b) of the HAS gelator-doped electronic ink

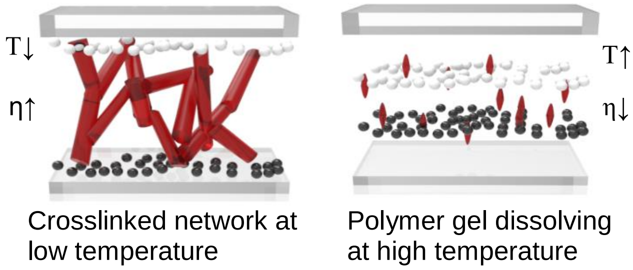
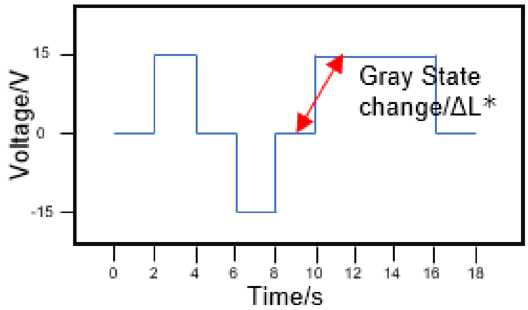


Fig 2. Working mode of the electronic ink with thermally reversible gelators.



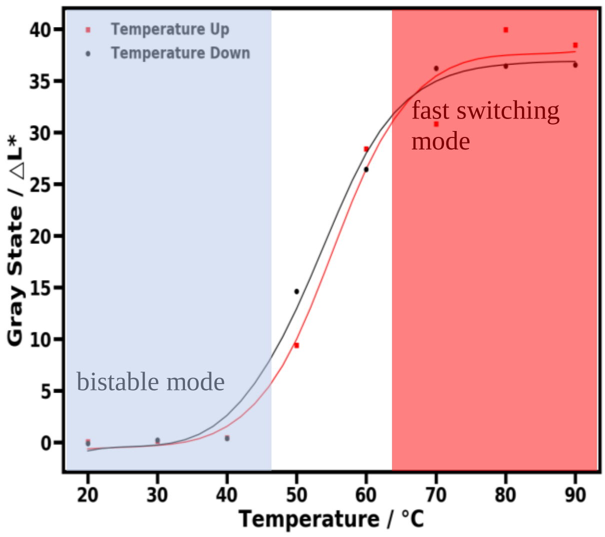


Fig 3. The change in gray state in different working mode under an applied 15V electric field.

[1] Bo-Ru Yang, Wen-jie Hu, Zeng Zheng. Understanding the mechanisms of electronic ink operation[J]. Journal of

the Society for Information Display, 2020.
[2] Deiber J A , Peirotti M B , María V. Piaggio. Interplay between electrophoretic mobility and intrinsic viscosity of polypeptide chains[J]. Electrophoresis, 2012, 33(6):990-999.
[3] Lin H C, Yang M R, Tsai S F, et al. Gelator-doped liquid-crystal phase grating with multistable and dynamic modes[J]. Applied Physics Letters, 2014, 104(1):127.
[4] Yoshie N, Watanabe M, Araki H, et al. Thermo-responsive mending of polymers crosslinked by thermally reversible covalent bond: Polymers from bisfuranic terminated poly(ethylene adipate) and tris-maleimide[J]. Polymer Degradation & Stability, 2010, 95(5):826-829.