Supplementary Information (SI) for Journal of Materials Chemistry A.

Anti-freezing polyacrylamide hydrogel electrolyte for rapid response self-powered electrochromic devices

Rui Ge[a, b], Xiudi Xiao[c*], Lirong Chen[a, b], Chengyu Jiang[a, b], Youliang Nie[a, b], Yanqing Zhu[a, b], Liuwen Zhong[a, b], Gang Xu[a, b*]

[a] School of Energy Science and Engineering, University of Science and Technology of China, Hefei 230026, China

[b] Guangdong Provincial Key Laboratory of New and Renewable Energy Research and Development, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, Guangzhou 510640, China

[c] School of Physics and Optoelectronics, State Key Laboratory of Luminescent Materials and Devices, South China University of Technology, Guangzhou 510640, China

E-mail: xiaoxiudi@scut.edu.cn; xugang@ms.giec.ac.cn.

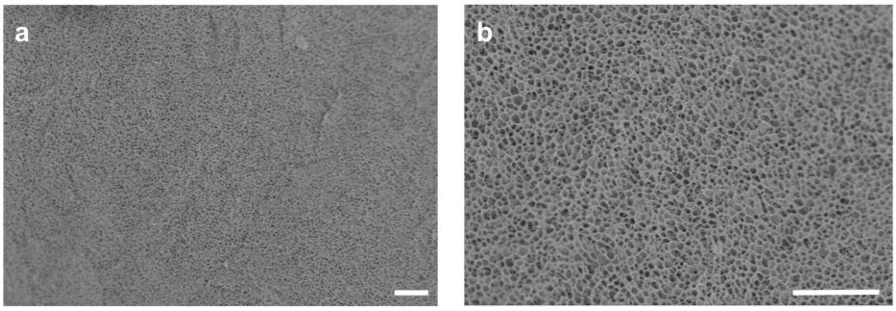

Figure S1 (a) and (b) SEM image at different scales of PAMCS after freeze drying, scale bar is 5μm.

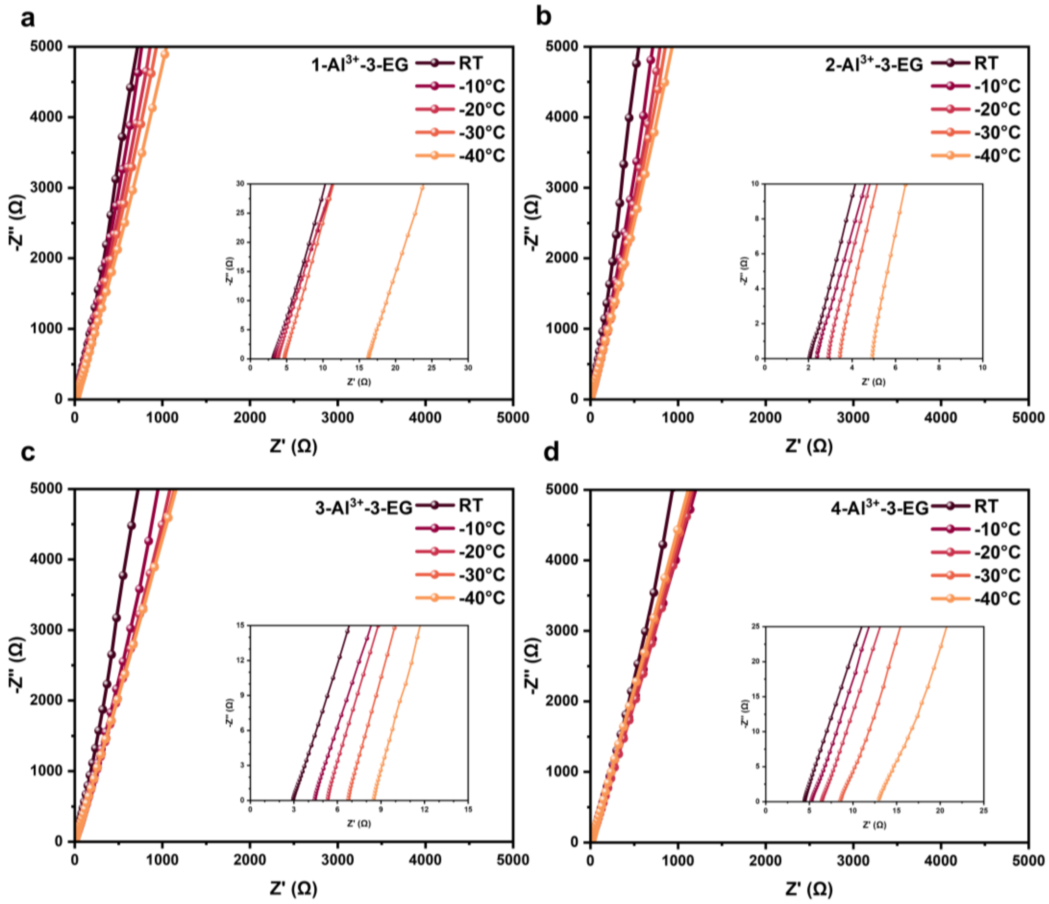

Figure S2 (a-d) AC impedance spectra of 1-Al^{3+}-3-EG, 2-Al^{3+}-3-EG, 3-Al^{3+}-3-EG, and 4-Al^{3+}-3-EG at different temperatures, respectively.

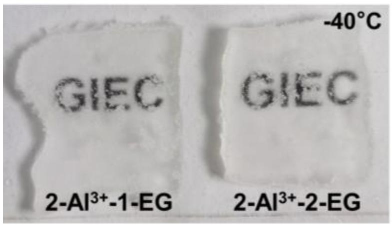

Figure S3 Photographs of the gel samples 2-Al^{3+}-1-EG and 2-Al^{3+}-2-EG at -40°C.

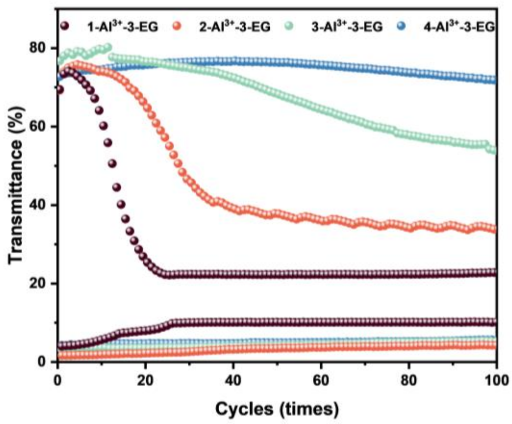

Figure S4 Cycle performance performed during CV cycling process between -0.2 and 1.4 V to record in situ changes of transmittance at 633 nm of four groups of devices.

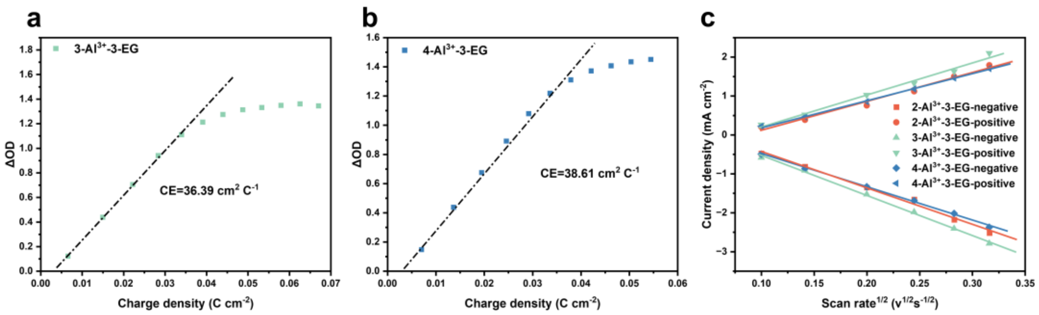

Figure S5 (a, b) The coloration efficiency of different devices, (c) scan rate dependence of the current density of the devices.

Figure S6 The thermometer placed in the low-temperature freezer for 1h indicates a stable internal temperature of -40°C.

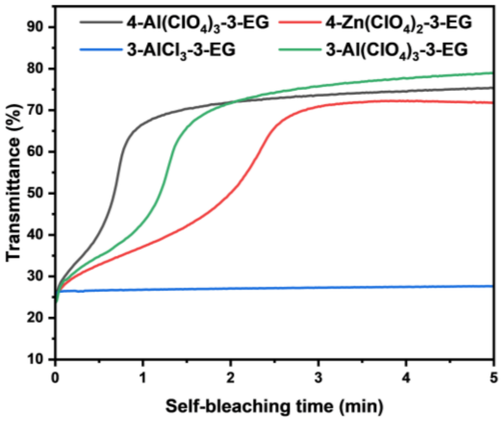

Figure S7 (a) The transmittance variations graphs of devices assembled with different gel electrolytes after 5 minutes of self-bleaching, following coloring to a similar transmittance level.

To investigate the effects of different salts on the self-bleaching performance of electrochromic devices, we designed comparative experiments. Maintaining the ratio of EG and water consistent with the content in the manuscript, we selected $Zn(ClO_4)_2$ and $AlCl_3$ to explore the effects of cations and anions, respectively. Additionally, due to the difficulty in preparing devices with gel electrolytes soaked in 4M $AlCl_3$ being affected by volume contraction, we controlled the concentration of $AlCl_3$ to 3M. In contrast, the gel soaked in 4M $Zn(ClO_4)_2$ did not exhibit volume contraction, so the concentration of 4M $Zn(ClO_4)_2$ was still used as the control parameter.

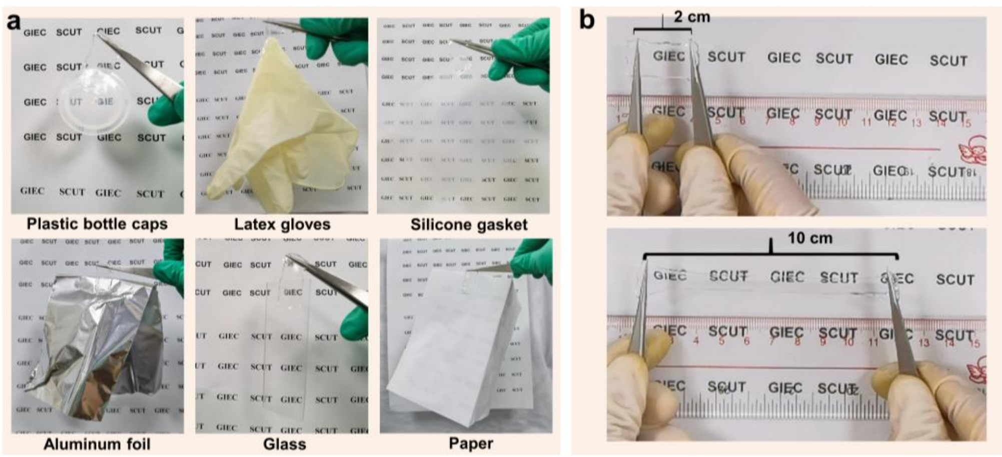

Figure S8 (a) Photos showcasing the adhesion strength of the gel on plastic, silicone, glass, metal foil, and paper, (b) tensile strength of the gel.

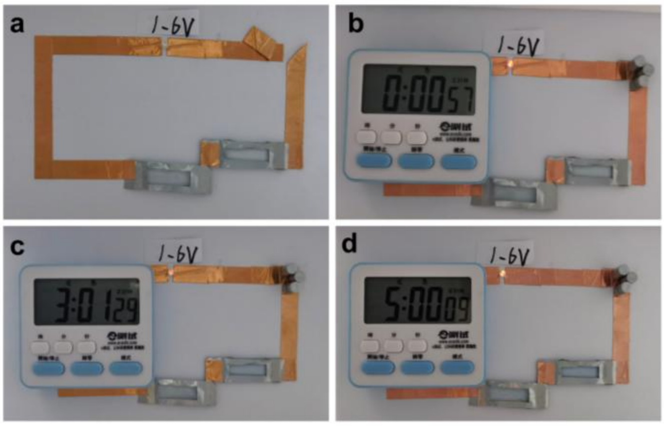

Figure S9 (a-d) Photographs of a 1.6 V LED powered by the prototype device over time.