Nanooptics and photonics

Electrochromic Li-ion battery

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Electrochromism is an electrically-controlled color change process [1] that manages reversible optical properties of the material while it's electrochemically oxidizing/reducing. Research on electrochromic devices is focused on modulation in the near infrared, thermal infrared and microwave regions where color alterations detect these wavelengths [2]. An interest in electrochromism is centered on displays, mirrors, and windows (each has unique requirements). They are mostly structurally similar, have full electrochemical cell configuration and all employ optically transparent electrode.

Nowadays, scientific attention is devoted to electrochromic windows (solution phase, hybrid designs, and battery-like) [3], which actively controlled and continuously tunable light transmission. In compare with displays and mirrors, electrochromic windows require double coloration efficiency per unit charge in the transmission mode. The environmental stresses on windows expected to be greater and the area exists sufficiently large, consequently, switching rate becomes limited by the sheet resistance of the transparent electrodes used to deliver current. However, some of the requirements are relaxed for small area window products like optical filters, eyewear, and charge detectors. There exist following challenges like high contrast ratio requires strong optical absorption, which limits the efficiency of the decoloring process; usage of fragile transparent and conducting electrodes, which restrict the potential of electrochromic materials; shape limitation. Herein, we represent that multi-layer graphene provides these challenging requirements [4].

We demonstrate new class rechargeable battery-like electrochromic device based on multi-layer graphene, which is flexible, self-decoloring and requires a maintenance current. This device could be used as a visible detector of own charge and external current source.

1 *Somani P. R. & Radhakrishnan S.* Electrochromic materials and devices: present and future. // Materials Chemistry and Physics. – 2003. – 77. – P. 117-133.

2 *Rosseinsky D. R. & Mortimer R. J.* Electrochromic Systems and the Prospects for Devices. // Advanced Materials. – 2001. – 13. – P. 783-793.

3 *Rauh R. D.* Electrochromic windows: an overview. // Electrochimica Acta. – 1999. – 44. P. 3165-3176.

4 *Polat E. O., Balcı O. & Kocabas C.* Graphene based flexible electrochromic devices. // Scientific Reports. – 2014. – 4. – P. 6484.