Investigation of Reversible Ionic Liquids Intercalation for Electrically Controlled Thermal Radiation from Graphene Devices

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Abstract

Using graphene as a tuneable optical material enables new class of unconventional optical devices such as switchable radar absorbers [1], variable infrared emissivity surface [2,3] or visible electrochromic devices [3]. These devices rely on controlling the charge density on graphene with electrostatic gating or intercalation [1-3]. Here we studied the effect of ionic liquid on the long-term performance of optoelectronic devices within broad infrared wavelength range. Our spectroscopic and thermal characterization results reveal the key limiting factors for the intercalation process and the performance of the infrared devices, such as the electrolyte ion-size asymmetry and charge distribution scheme, and the effects of oxygen. Our results provide a roadmap for realistic application of graphene for infrared thermal management and dynamic heat signature control.

References

[1] Balci, O. et al. Nature communications, 6 (2015) 1-10.
[2] Salihoglu, O. et al. Nano letters, 18 (2018) 4541-4548.
[3] Ergoktas, M. S. et al. Nature photonics 15 (2021) 493-498.

Figures

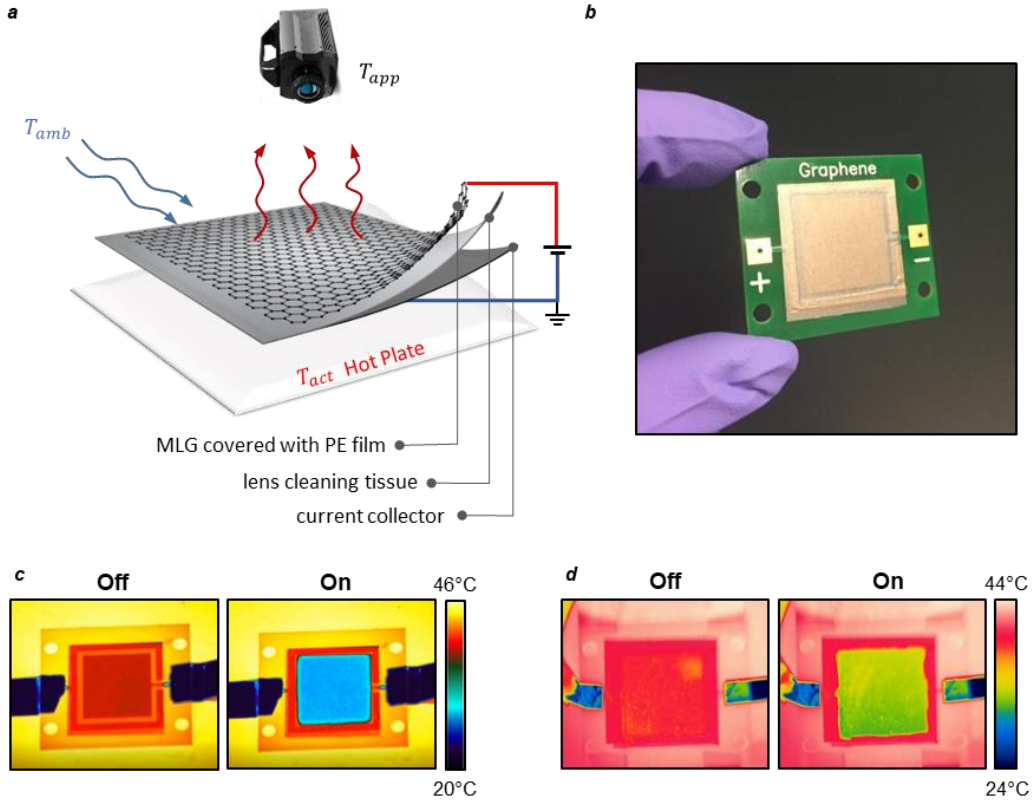

Figure 1: (a) Schematic structure of device consists of 3 laminated layers. The thermal characterization setup includes a long-wavelength IR or mid-wavelength IR camera and a hot plate. **(b)** Photograph of a device fabricated on a printed circuit board using gold plated current collector. **(c,d)** Thermal camera images of the device at high and low emissivity state recorded by (c) MWIR (3-5 μm) and (d) LWIR (8-14 μm) cameras. Broad tuneable absorption of graphene enables modulation of apparent temperature both at mid and long wavelength infrared ranges.