2015 中技社科技研究獎學金

CTCI Science and Technology Research Scholarship

光敏化石墨烯於光電元件之應用

Applications of Optically Activated Graphene for Optoelectronic Devices

國立臺灣大學 材料科學與工程學系暨研究所

博士班三年級 何柏勳　指導老師:陳俊維 教授

Corresponding

chunwei@ntu.edu.tw

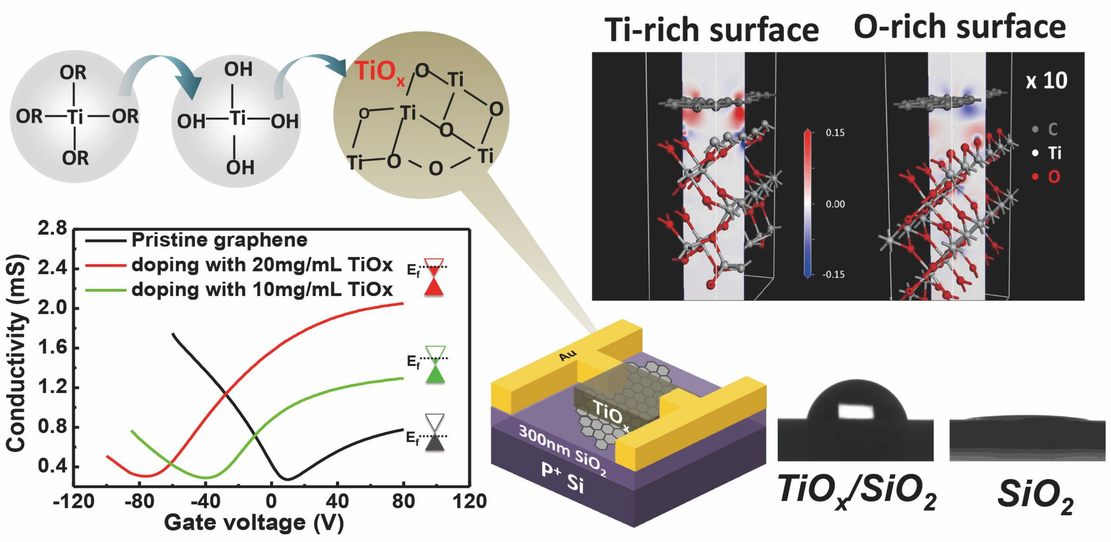
river770323@gmail.com

研究重點

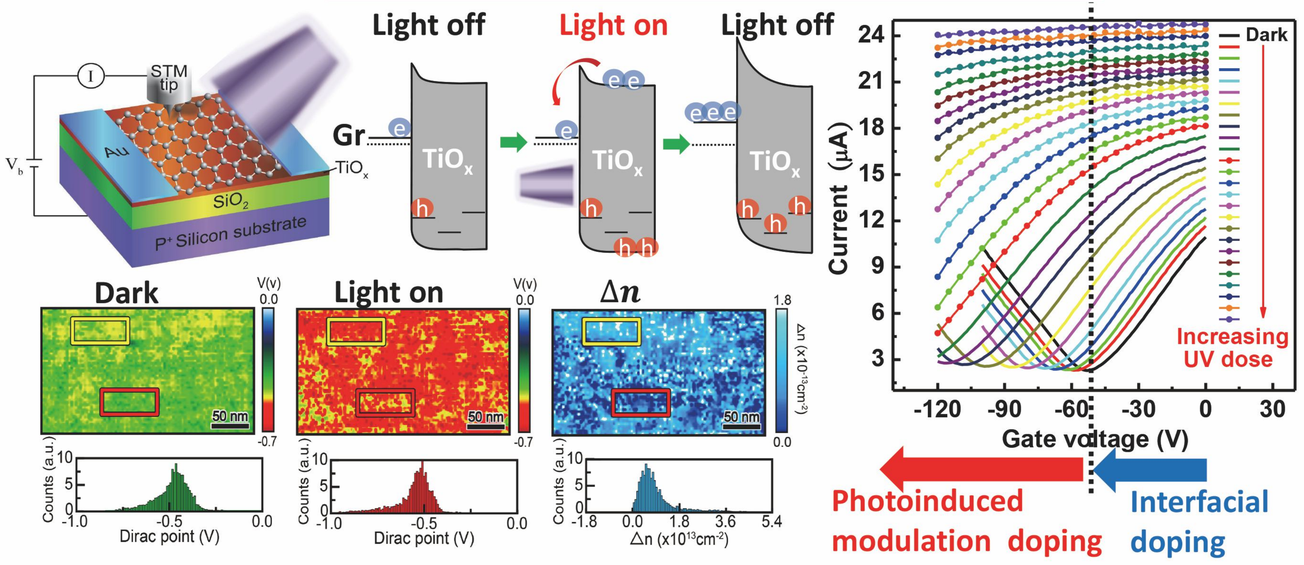
Doping of graphene results in its tunable electronic properties; thus, it is a potential candidate for use in electronic applications such as metal–oxide-semiconductor (CMOS) transistors, transparent conducting electrodes, gas sensors, and thermal electric devices. However, conventional chemical doping only approximately controls the doping level of graphene with different concentrations or thicknesses of dopants, thus confining the application of graphene-based electronics. Therefore, another strong light–matter interaction in graphene-based heterostructure devices has been investigated in this work. Photoactive materials deliver photoexcited carriers to graphene, contributing to photoinduced doping. This technique makes the doping process reversible and controllable through light modulation, broadening the application range of graphene-based electronic devices.

研究成果

TiO_x - a self-encapsulated n-type dopant



TiO_x - a "photoactive" n-type dopant

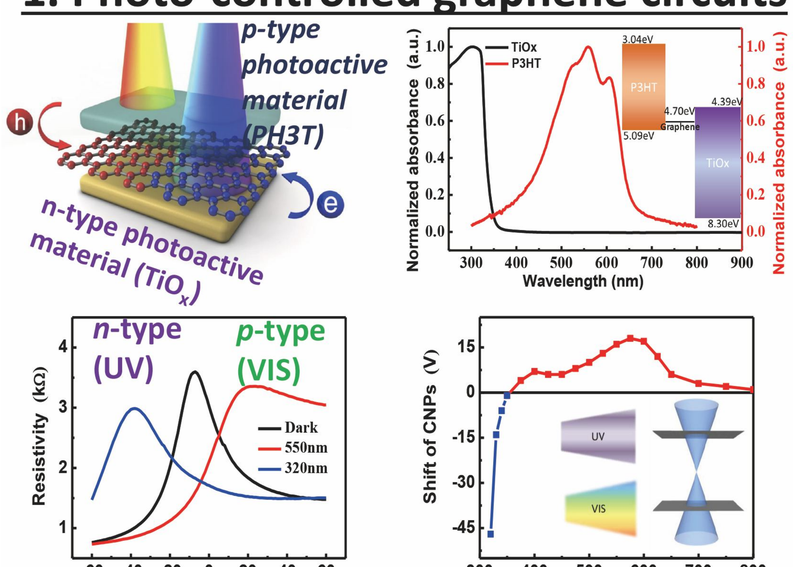


Roughly control doping level by various concentration of dopants

Precisely control doping level with different dose of light

Applications of photoactive TiOx/Grapheneheterostructure

1. Photo-controlled graphene circuits



Wavelength-selective transport behavior

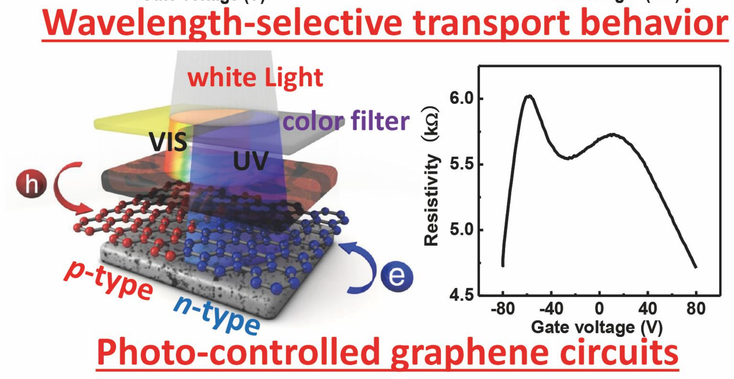
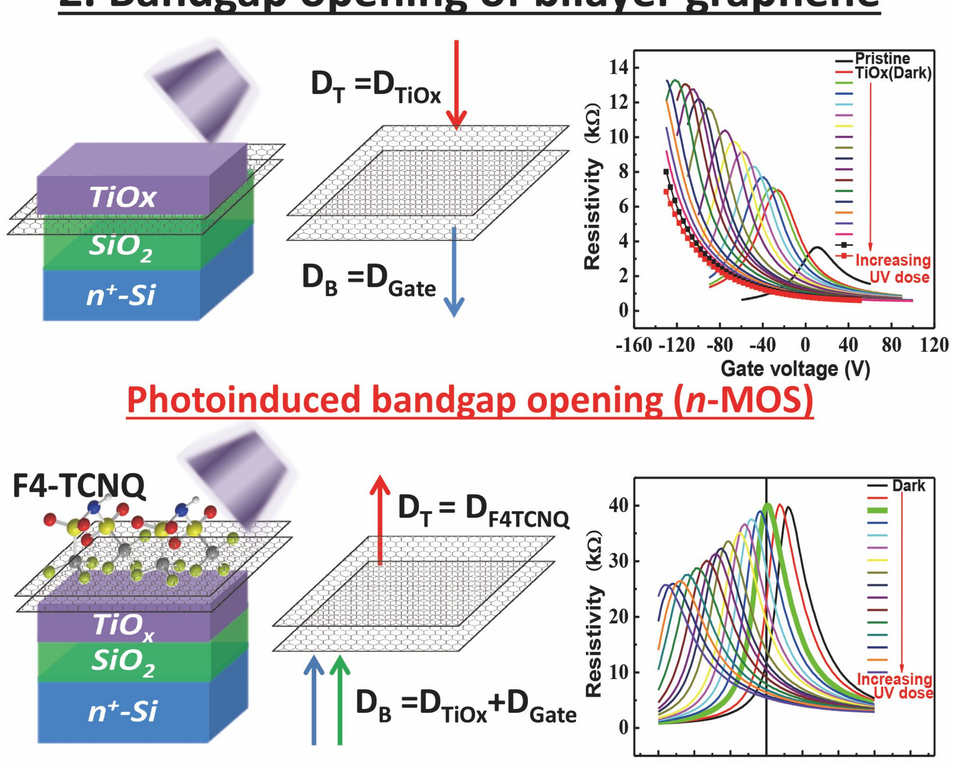


Photo-controlled graphene circuits

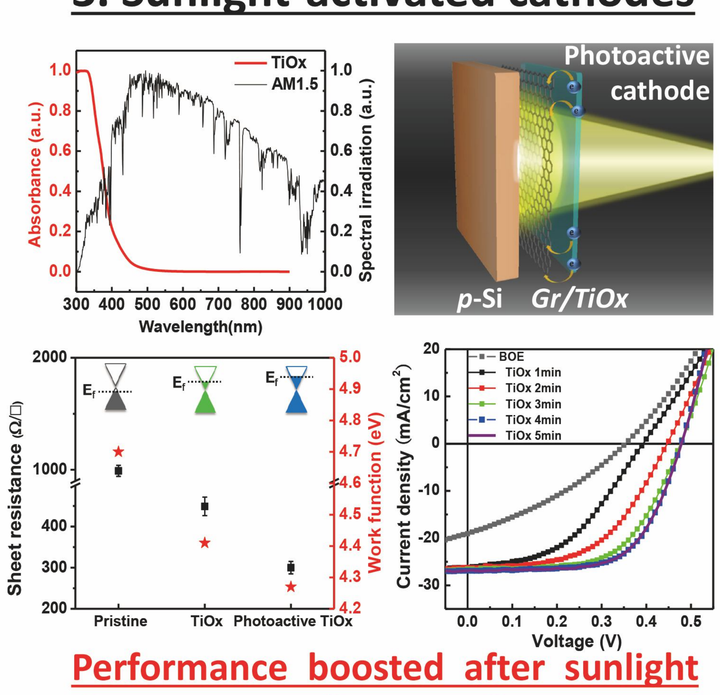
2. Bandgap opening of bilayer graphene



Photoinduced bandgap opening (*n*-MOS)

Normally-off *p*-MOS

3. Sunlight-activated cathodes



Performance boosted after sunlight illumination (best efficiency of graphene based cathodes so far)

Reference

1. Ho, Po-Hsun, et al. **2012,** *ACS Nano,* **6**, 6215-6221.
2. Ho, Po-Hsun, et al. **2015,** *Adv. Mater.*, **DOI:** 10.1002/adma.201503592
3. Ho, Po-Hsun, et al. **2015,** *Adv. Mater.*, ***27***, 282-287.
4. Ho, Po-Hsun, et al. **2015,** *Adv. Mater,* **27**, *1724-1729.*
5. Ho, Po-Hsun, et al. **2015,** *Energ. Environ. Sci.* **8**, 2085-2092.

研究生活及心得

很榮幸能夠獲得中技社科技獎學金，感謝獎學金的設置者們，這筆獎學金在我未來的規劃具有相當大的幫助。感謝我的父母不管任何情況總是在背後支持著我，也感謝我的指導老師陳俊維教授幾年來的指導。在實驗的生活中總是交雜著各種苦悶、挫折、驚喜，很感謝實驗室同儕們這幾年中的陪伴，期許自己獲獎後能夠有機會貢獻自己所學。

財團法人 中技社 CTCI FOUNDATION