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Toward High Performance Graphene-based Solar Cells: Spectroscopic Study on Doped Graphene[1] JAN-KAI CHANG, Department of Physics, Caltech; Graduate Institute of Photonics and Optoelectronics, National Taiwan University, CHEN-CHIH HSU, WEI-HSIANG LIN, Department of Physics, Caltech, CHIH-I WU, Graduate Institute of Photonics and Optoelectronics, National Taiwan University, NAI-CHANG YEH, Department of Physics, Caltech — A polymer-free transfer method with in situ doping process for graphene, aiming at simple and efficient doping of residue-free graphene, has been developed to achieve stacked graphene/dopant intercalation films. The proposed facile strategy led to a tunable work function from 3.25 eV to 5.10 eV, enabling graphene anode and cathode for solar cell devices. Both hybrid and organic photovoltaics using graphene electrodes have been carried out with a series of optimization based on spectroscopic characterizations. Since aging of doped graphene is crucial to the lifetime of graphene-based solar cells, the doping-induced electronic state variation with time has been investigated via X-ray and ultra-violet photoemission spectroscopy analysis to gain insight in its electronic properties and stability. The doping effect developed in graphene has also been studied via Raman spectroscopy, including time evolution of the Raman D, G and 2D bands under normal and humid conditions for up to 30 days. This systematic investigation of aging effect provides better understanding and helps optimize the stacking of doped graphene films for achieving high performance graphene-based devices.

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Jan-Kai Chang
Department of Physics, Caltech; Graduate Institute of Photonics
and Optoelectronics, National Taiwan University

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