Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Theory of hot electron photoemission from graphene LAY KEE ANG, SHIJUN LIANG, Singapore University of Technology and Design — Motivated by the development of Schottky-type photodetectors, some theories have been proposed to describe how the hot carriers generated by the incident photon are transported over the Schottky barrier through the internal photoelectric effect. One of them is Fowler's law proposed as early as 1931, which studied the temperature dependence of photoelectric curves of clean metals. This law is very successful in accounting for mechanism of detecting photons of energy lower than the band gap of semiconductor based on conventional metal/semiconductor Schottky diode. With the goal of achieving better performance, graphene/silicon contact-based- graphene/WSe2 heterostructure-based photodetectors have been fabricated to demonstrate superior photodetection efficiency. However, the theory of how hot electrons is photo-excited from graphene into semiconductor remains unknown. In the current work, we first examine the photoemission process from suspended graphene and it is found that traditional Einstein photoelectric effect may break down for suspended graphene due to the unique linear band structure. Furthermore, we find that the same conclusion applies for 3D graphene analog (e.g. 3D topological Dirac semi-metal). These findings are very useful to further improve the performance of graphene-based photodetector, hot-carrier solar cell and other kinds of sensor.

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Date submitted: 03 Dec 2015 Electronic form version 1.4