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New Aspects of Photocurrent Generation at Graphene pn Junctions Revealed by Ultrafast Optical Measurements[1] GRANT AIVAZIAN, DONG SUN, AARON JONES, JASON ROSS, University of Washington, WANG YAO, University of Hong Kong, DAVID COBDEN, XIAODONG XU, University of Washington — The remarkable electrical and optical properties of graphene make it a promising material for new optoelectronic applications. However, one important, but so far unexplored, property is the role of hot carriers in charge and energy transport at graphene interfaces. Here we investigate the photocurrent (PC) dynamics at a tunable graphene pn junction using ultrafast scanning PC microscopy. Pump-probe measurements show a temperature dependent relaxation time of photogenerated carriers that increases from 1.5ps at 290K to 4ps at 20K; while the amplitude of the PC is independent of the lattice temperature. These observations imply that it is hot carriers, not phonons, which dominate ultrafast energy transport. Gate dependent measurements show many interesting features such as pump induced saturation, enhancement, and sign reversal of probe generated PC. These observations reveal that the underlying PC mechanism is a combination of the thermoelectric and built-in electric field effects. Our results enhance the understanding of non-equilibrium electron dynamics, electron-electron interactions, and electron-phonon interactions in graphene. They also determine fundamental limits on ultrafast device operation speeds (∼500 GHz) for graphene-based photodetectors.

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