論文の内容の要旨

Carrier dynamics in graphene on SiC studied by time-resolved photoemission spectroscopy

（時間分解光電子分光法によるSiC基板上グラフェンのキャリアダイナミクス研究）

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Graphene, a 2-dimensional material composed of carbon honeycomb structure, possesses remarkable electric and optical properties such as broadband photoabsorption, high carrier mobility and ultrafast optical response. These anomalous properties stem from massless Dirac Fermions showing a linear energy-momentum dispersion called ”Dirac cone”. Since a recent discovery of graphene, studies about fundamental properties of graphene has been always center of the attention in the wide range of academic fields. Owing to an accumulation of many researches, some graphene-based devices started to be used in a commercial way. An opto-electronic application of graphene is also highly promising, however, a comprehensive understanding of carrier dynamics in graphene is still missing.

In the present study, we systematically studied carrier dynamics in graphene on SiC substrate by time-resolved photoemission spectroscopy. First, a characteristic carrier scattering of Dirac Fermion was examined at first time in graphene on Si-face SiC(0001)

surface which shows strong electron doping and electron-electron scattering in the time scale of several hundred femtoseconds. Furthermore, electron-phonon scattering and electron-defect scattering are circumstantially investigated in graphene on C-face SiC(0001). A combination technique of time-resolved photoemission spectroscopy and numerical model analysis revealed the whole relaxation picture within the time scale of femtoseconds to several picoseconds. Finally, charge transfer dynamics at graphene/SiC interface and the influence of the interface structure was examined up to sub-microseconds region utilizing a laser-pump synchrotron radiation-probe time-resolved photoemission measurement.

As a consequence of a series of time-resolved photoemission measurements, we clearly identified individual relaxation pathways and uncover the overall time structure of carrier dynamics in graphene/SiC system ranging from femtosecond to microsecond time scale.