Title: Study of ultrafast electron dynamics in twisted multilayer graphene using femtosecond photoemission electron microscopy

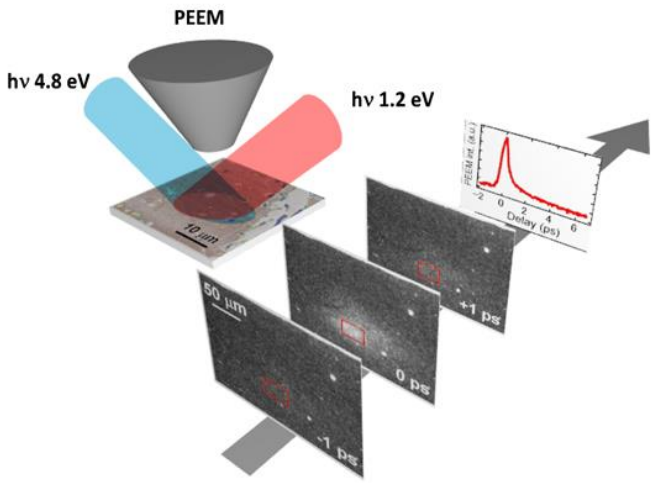
Context:

The lack of bandgap has limited the scope of application of graphene in electronic devices. In contrast, multilayer graphene may exhibit a finite band gap in the presence of electric field that can be exploited for applications. **T**wisted **m**ulti**l**ayer **g**raphene (tMLG) exhibits random twist angles between the graphene layers that may affect its dynamic as well as electronic properties. In this regard, these novel nanoscale materials offer an excellent opportunity to explore the dependence of electron dynamics on the twist angle. The results are expected to provide valuable insight into the importance of tMLG vis-à-vis applications.

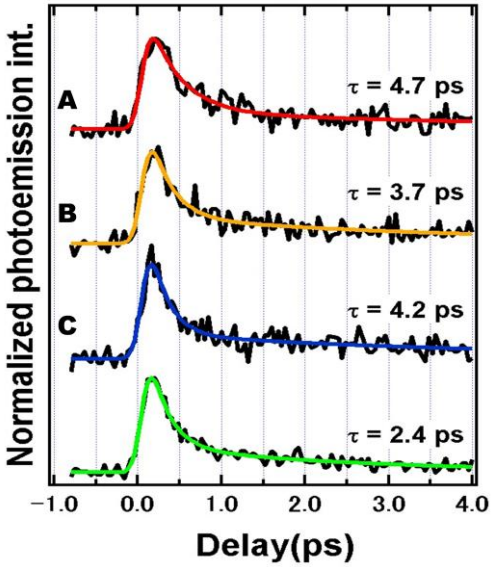
In this work, researchers have identified distinct features in tMLG using micro Raman spectroscopy and calculated the corresponding electronic states. Subsequently, they have located the same superstructures using femtosecond photoemission electron microscopy (fs-PEEM) and observed the electron dynamics in various tMLG samples in order to correlate the structures with the electron transport properties. The results have been published in Carbon (Carbon 124 (2017) 49-56) on August 17, 2017.

Abstract:

tMLG presents electronic properties that depend on the relative misalignment and interaction between layers. These interactions affect the band structures and carrier dynamics upon photonic excitation. These structures are being studied intensively, and recent work has highlighted the strong potential they offer for optoelectronic devices. However, the study of ultrafast carrier dynamics is still in a nascent stage, mostly due to instrumental limitations. In this study, we have investigated the carrier dynamics of chemical vapor deposited (CVD) twisted graphene superlattices with different interlayer rotation angles using fs-PEEM. The photogenerated carrier lifetimes in the selected regions are longer compared to that of monolayer graphene. This observation is explained by the presence of a band gap and subbands in trilayer graphene, and has been supported by density functional theory calculations.



Schematic representation of the fs-PEEM experiment on CVD superlattices



Recombination carrier lifetime measured using fs-PEEM for three different tMLG samples

Reference: Ultrafast electron dynamics in twisted graphene byfemtosecond photoemission electron microscopy

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