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Ultrafast Carrier Dynamics in Graphene and Few Layer Graphite[1]

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Graphene and its multilayer counterparts provide unique opportunities to study how the ultrafast carrier dynamics of layered systems evolve with layer number. We have carried out systematic investigations [1] of layered graphitic materials, from graphene to bulk graphite, exfoliated on to a Si/Silicon oxide substrate. The samples are excited using 150 fs, 800 nm pulses at room temperature and the time resolved reflectivity and transmission is probed using 150 fs, 1300 nm pulses. The response is governed by two times constants, one near 250 fs and the other near 3 ps, but both vary with the number of layers. The time constant are related to carrier cooling kinetics, interband transitions and hot phonon effects. The change in the first time constant with layer number is discussed in terms of alterations to the band structure with increasing number of layers over a few layers while the changes in the longer time constant over 10's of layers is related to substrate coupling effects. The results are compared with results from related experiments [2,3] using multilayer graphene, epitaxially grown on SiC, and also from results from experiments [4] using freestanding, thin graphite layers. *Work carried out with R.W. Newson and J.J. Dean.

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