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Ultrafast relaxation dynamics of hot carriers and phonons in graphene-diamond interface: a study towards Carbon sp2 on sp3 technology ZEYNAB JARRAHI, JUSTIN GREGORY, HALINA KRZYZANOWSKA, STEPHANIE GILBERT CORDER, JOY GARNETTE, JIMMY DAVIDSON, NORMAN TOLK, Vanderbilt University — The attraction of graphene in the device arena stems from graphene's high electron mobility and the ability to integrate it on almost any substrate [1]. It has been shown that diamond might be the ultimate substrate of choice for graphene FET and interconnects where the increased performance of Gr/diamond FET has been attributed to the superiority of diamond as a heat sink [2]. This process is ultimately dependent on hot carrier and phonon relaxation dynamics in the Gr /diamond interface which remains unknown to this date. Using ultrafast pump probe spectroscopy, we will contrast the population dynamics of photoexcited carriers and optical and acoustic phonons in CVD grown single layer graphene transferred onto single crystal (111) and (100) as well as poly crystalline diamond substrates. The transient differential reflection spectra will reveal the time scales associated with the cooling cascade of non equilibrium photo generated species. Understanding how relaxation dynamics of graphene is altered by coupling to different diamond interfaces and the effect of diamond on the scattering mechanisms involved, will pave the way towards realization of higher performance carbon sp2/sp3 technology.

[1] Novoselov et al. Nature 2005, 438, 197– 200
[2] Yu et al. Nano Letters 2012 12 (3), 1603-1608

Zeynab Jarrahi
Vanderbilt University

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