Investigating carrier transport in graphene on diamond

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Graphene has outstanding electronic and thermal properties that makes the material interesting as a candidate in many applications e.g. ultra-fast transistors. However, due to its 2D-nature, self-heating and the lack of suitable supporting substrate has detained the progress in this field. Diamond provides a good alternative to more common SiO_2/Si substrates because of an excellent heat capacity and its electrical and chemical stability. In this study, we fabricate graphene-diamond hybrid structures by transferring graphene on top of a high-purity single crystalline diamond sample. Hall-effect measurements were conducted at 80 to 300 K on graphene Hall bars to investigate the charge transport properties. Graphene showed maximum hall mobility of 2750 $cm^2V^{-1}s^{-1}$ for holes and 1600 $cm^2V^{-1}s^{-1}$ for electrons at 300 K. In addition, by systematically varying the voltage on the gated Hall bars we concluded that the main scattering mechanism in the graphene came for longer range coulomb scattering. The results are highly important and promising to achieve charge injection into diamond and to demonstrate freestanding carbon-carbon (C-C) devices.

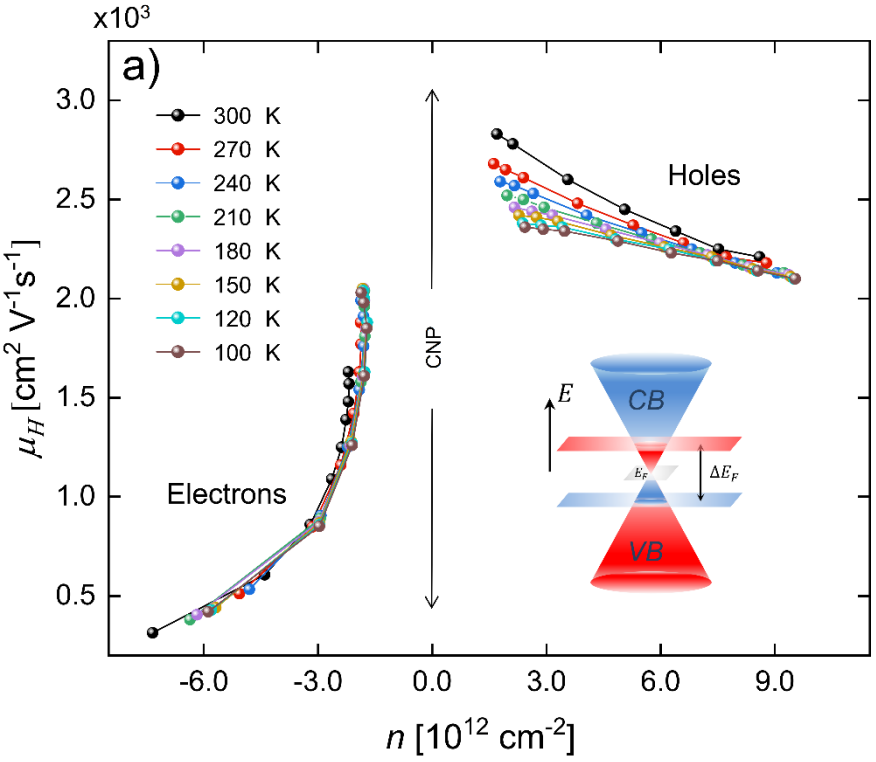

Fig 1: Hall mobility of graphene on diamond for both hole and electrons at different temperatures as a functions of carrier concentrations.