Ambipolar Electronics using Graphene

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Gate voltage-controlled graphene field-effect devices (GFED) allow unique ambipolar conduction that can be exploited for novel electronics. The basic principle of ambipolar electronics is to control *both* the channel carrier *type* and *density* by modulating the gate voltage and utilize its effect of on a carrier-density-dependent signal or device property.
Graphene conductivity is an even function of gate voltage that has been employed for RF applications such as frequency multiplier [1], mixer [2], tripler [3], and quadrupler [4]. However, the concept can be readily generalized as there are other carrier-density-dependent device properties that can use the ambipolar conduction of Graphene; such as, magnetic field sensitivity of a Graphene-based Hall-effect sensor [5] and Seebeck coefficient of a Graphene photo-thermoelectric device [6]. Both of these effects exhibit odd response function under gate voltage modulation. Indeed, multiple device properties can be used together to create novel device function.
We demonstrate Graphene Hall-effect device as an example of ambipolar electronic device that utilizes both even conductivity function and odd Hall sensitivity function to achieve low-offset Hall sensor [7, 8].

References

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Figures

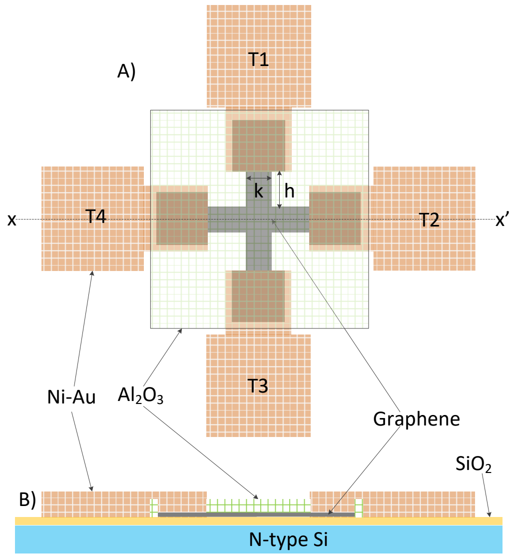

Figure 1: A) Layout and B) cross section at xx' of Graphene Hall sensor (not to scale)

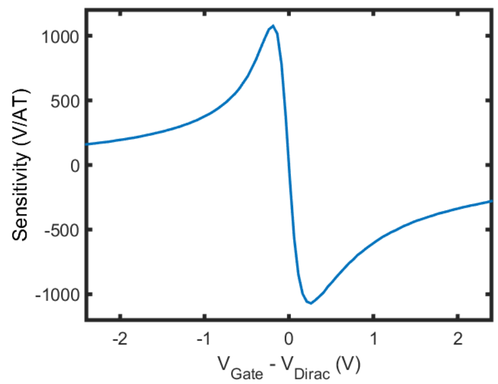

Figure 2: Magnetic sensitivity vs. gate voltage of a Graphene Hall sensor