Stable high-sensitivity Hall sensors, based on scalable CVD graphene with polymeric encapsulation

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Magnetic field sensors based on Hall effect have an extremely wide array of applications, ranging from automotive, to consumer electronics and robotics. The use of graphene as the sensing media enables the miniaturisation of these devices, while maintaining high sensitivity [1]. To date, most high-performing graphene Hall sensors have been based on exfoliated materials, making them incompatible with industrial production. In this work we demonstrate highly sensitive Hall sensors based on high-quality CVD-grown single-crystal graphene [2]. We fabricate the devices using ultra-clean processing [3], allowing to achieve high carrier mobility >7 500 $cm^2 V^{-1} s^{-1}$. Crucially, we coat these devices using spin-coated polymeric (PMMA) encapsulation, allowing to preserve their performance when exposed to ambient conditions for many days. Indeed, as can be seen in figure 1, electrical transport and magnetic response of encapsulated devices shows negligible degradation, a stark difference to the performance of devices based on bare graphene. The devices achieve sensitivity ~2747 V/AT and minimum detectable magnetic field ~1.8 $mT/Hz^{0.5}$.

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References

[1] Collomb et al, *Journal of Physics: Condensed Matter* **33** (2021) 243002
[2] Miseikis et al, *2D Materials* **4** (2), (2017) 021004
[3] Tyagi et al, *Nanoscale* **14** (2022) 2167-2176

Figures

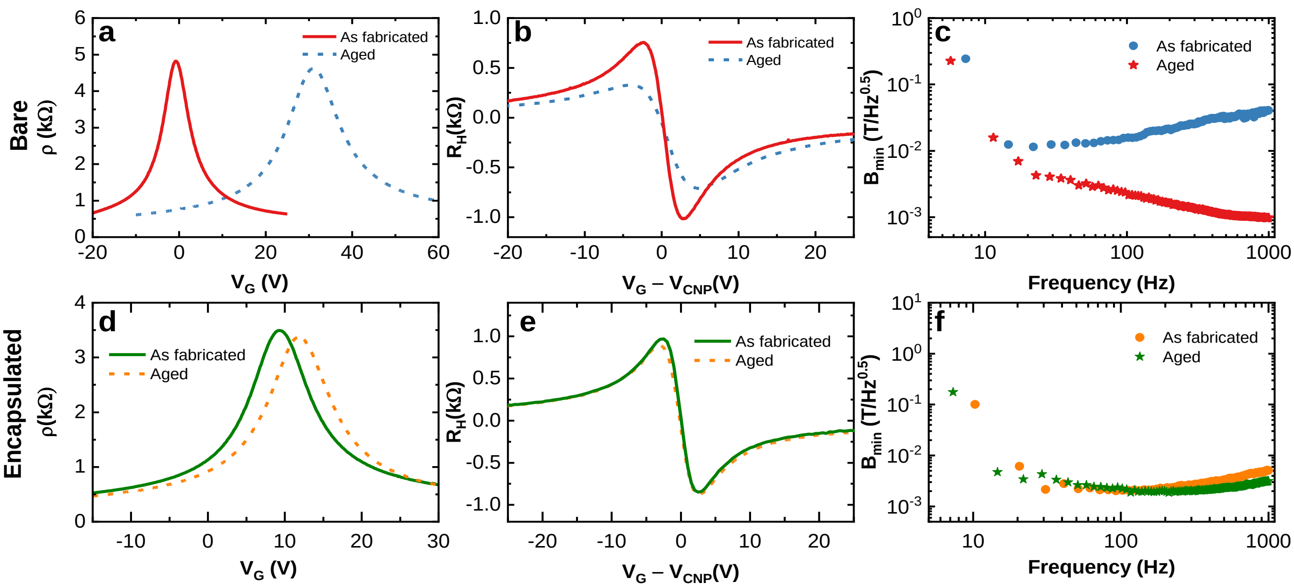

Figure 1: Stability of electrical and magnetic response of Graphene Hall sensors without (a-c) and with (d-f) PMMA capping. (a), (d) Resistivity and (b), (d) Hall resistance as a function of gate voltage. (c), (f) minimum magnetic field as a function of frequency.