Sustainable synthesis and processing of graphene acetic acid for electronic devices

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Nowadays, many societal challenges are arising related to environmental sustainability. Within this context, the development of sustainable approaches to fabricating electronic devices is of paramount importance to envision the future electronics that must support our daily actions.
Here, it presents a green and robust protocol for processing a novel derivative of graphene, namely graphene acetic acid (GAA), whose backbone differs from graphene acid (GA)[1] by the presence of a methylene unit between the C sp2 basal plane and the carboxylic groups (-COOH), as shown in Fig.1. Its satisfactory water dispersibility together with a conductivity similar to the reduced graphene oxide (rGO)[2] allows one to implement GAA into supercapacitors and liquid-gated transistors with a straightforward and robust protocol. In particular, a Zn hybrid supercapacitor shows a state-of-the-art capacitance equal to 400 F/g at a current density of 0.05 A/g. Furthermore, the successful fabrication of a liquid-gated transistor (LGT) relies on the deposition of two different GAA layers, namely one placed onto the gate terminal and another one placed onto the interdigitated electrodes (Fig.1). This type of transistor shows similar performances compared to the rGO-based one,[3] namely V_{DIRAC} > 100 mV (i.e. p-doping), field-effect mobility equal to 10^{-1} $cm^2V^{-1}s^{-1}$ and a potentiometric sensitivity down to 3 mV. Moreover, it boasts a more straightforward fabrication and sound robustness for prolonged measurements (i.e. > 1 h) in an aqueous solution driven by paper fluidics. Finally, we show an appealing alternative to rGO, which is the only graphene-related material well-suited for these electronic applications. Sustainability and device throughput are the strongest advantages of exploiting GAA within this context.

References

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Figures

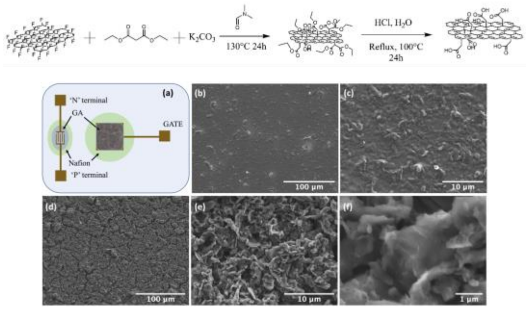

Figure 1: Upper part: synthesis scheme of the GAA. Lower part: LGT layout and SEM images of GAA layers