Graphene and other 2d crystals: the road to applications

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Technological progress is driven by developments in material science. Breakthroughs can happen when a new type of material or new combinations of known materials with different dimensionality and functionality are created. Graphene, because of its many superior materials properties [1,2], has the opportunity to enable new products. Graphene is just the first of a new class of two dimensional (2d) materials, derived from layered bulk crystals. The assembly of such 2d crystals (heterostructures) will provide a rich toolset for the creation of new, customised materials [3].

Here I will provide an overview of the key aspects of graphene and related materials (GRMs), for their applications in a large number of sectors, highlighting the roadmap to take GRMs from a state of raw potential to a point where they can revolutionize multiple industries: from flexible, wearable and transparent electronics to high performance computing and spintronics. This will bring a new dimension to future technology: a faster, thinner, stronger, flexible, and broadband revolution [4].

I will review the state of the art of graphene preparation, production, placement and handling [5]. In particular, I focus on solution processing of GRMs [5,6,7], offering a simple and cost-effective pathway to fabricate 2d crystal-based heterostructures and optoelectronic devices, having benefits in flexibility and integration compared to conventional production methods being also the ideal starting point to produce printable inks [7].

Then, I will give a brief overview on how the GRM-based inks produced using the above mentioned approaches, are used to fabricate composites and thin films for photonic, optoelectronic and energy applications [2]. In particular, I will focus on flexible transparent conductors [2], liquid crystal based smart windows [2], dye sensitized solar cells [2], Li-ion batteries, and ultrafast lasers [8,9].

References

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