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Graphene-based materials and their polymer composites for flexible electronics and biomedical applications

Graphene-based materials biocompatibility

Studies frequently show that mammalian cell viability decreases slightly after exposure to graphene-based materials (GBMs). These materials were shown to induce oxidative stress and apoptosis. The most hydrophilic forms of GBMs were found to penetrate the cellular membrane. Even so, these materials were found to be generally less toxic than hydrophobic forms, which accumulate on cell membrane surfaces.
The *in vivo* effect of GBMs depends on their physical–chemical properties, concentration, time of exposure, and administration route, and also on the characteristics of the animals used. Most studies report no occurrence of adult animal death. However, there are some reports of GBMs accumulation and histological findings associated with inflammation, and, more rarely, fibrosis. Encapsulation of GBMs in a matrix reduces potential toxicity. In addition, incorporation of hydrophilic forms improves cell adhesion at biomaterials surface. Some reports of antibacterial properties and improved hemocompatibility in GBM-based composites offer interesting perspectives for future research and developments. [1]

Graphene-based materials and their polymer composites for biomedical applications

Production and characterization of polymer/graphene composites, exploring and improving available methods was performed, in parallel with the characterization of graphene-based materials biological properties when dispersed in liquid media, and the effect of their morphology, degree of oxidation, and surface modification with polymers. These materials have potential uses in biomedical implants for orthopedics and cardiology, amongst others. [2]

Graphene-based materials for flexible electronics

Low-cost high-throughput printing of solution processed electronics is a rapidly expanding field that already encompasses many large-scale applications such as roll-to-roll printed solar cells, including current collecting grids, displays, and radio frequency identification (RFID) devices. Here, solution-processed graphene holds considerable promise for printed electronics as it is widely available, inexpensive, flexible, and most importantly, highly conductive. For flexible electronic devices, *e.g.*, organic photovoltaics, a sheet resistance < 10 Ω/□ mil is required, while for printed RFID antennas, one needs a few Ω/□ mil. Following printing of the conductor pattern, typically post-treatments such as drying, annealing, or top-coating can be employed to maximize conductivities. The conditions of post-treatment define the substrate that can be used for printing. Materials with suitable properties for above mentioned applications were obtained and new strategies are under development. [3]

References

[1] Pinto *et al.*, Colloids Surf B 111 (2013) 188.
[2] Pinto *et al.*, Carbon 99 (2016) 318.
[3] Kirill *et al.*, Adv. Funct. Mater 26 (2016) 586.

Figures

Figure 1:

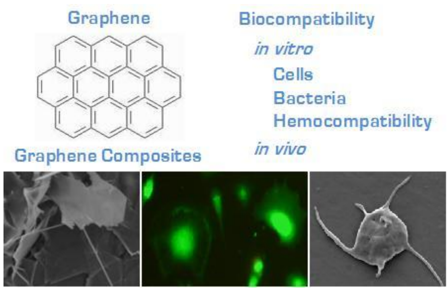

Figure 2: