Electromagnetic and electromechanical applications of graphene-based materials

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The pervasive diffusion of wireless consumer electronics has increased the attention on the risks of electromagnetic interference (EMI), and has pushed towards the development of innovative and cost-effective electromagnetic (EM) shielding solutions. Moreover, EM shielding of radio frequency (RF) radiation in the frequency range up to a few tens of gigahertz is becoming more and more challenging due to the increasing demand for electronic devices integrating smartness and multifunctionality, with lightness, small size, ergonomics, fashion trends.

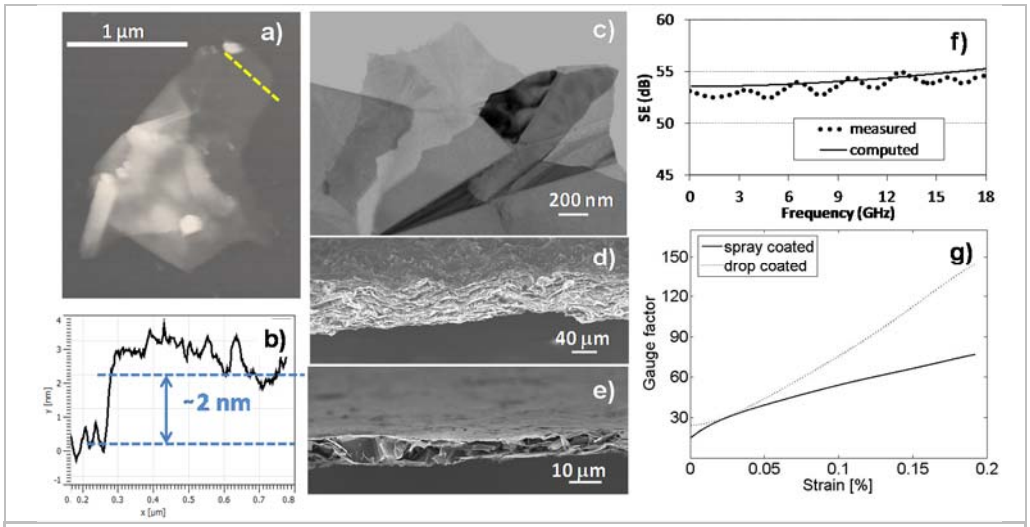

Figure 1: AFM (a,b) and STEM characterization of GNP flakes (b). SEM of the cross section of GNP papers before and after thermal annealing and mechanical compression (d,e). Shielding effectiveness of a GNP paper (f) and gauge factor of GNP-based sensor (g).

Due to their high electrical conductivity, metals are by far the most commonly used materials for EM shielding at RF. However, the use of metals in advanced multifunctional shielding solutions has some limitations, typically related to their high-density that prevents lightweight solutions. Moreover, metals are subjected to corrosion in harsh environment, and most of them are classified as "critical raw materials" by European Commission. In addition, the widespread use of plastics in consumer electronics packaging and the increasing interest in flexible electronics are pushing towards the development of new shielding metal-free solutions. Within this context, recently carbon-based materials have gained popularity thanks to their light weight, resistance to corrosion, electrical and thermal conductivity, multifunctionality [1,2,3]. In particular, carbon nanotube (CNT) and graphene nanomaterials, such as graphene oxide (GO) and multilayer graphene (MLG) micro- and nanosheets, also known as graphene nanoplatelets (GNPs), have been widely investigated in the last decade.
A promising class of graphene-based materials for large-scale exploitation in engineering, and in particular for electromagnetic shielding [4] and strain sensing [5] applications, are GNPs produced by thermochemical exfoliation of intercalated graphite compounds and their derivatives, like GNP-polymer composites [4-6], GNP-papers [7] or GNP-flexible shielding foils.
The presentation will provide an overview of the recent results and application of GNP-based materials for radar-absorbing screen, highly electromagnetic shielding foils, high-sensitivity strain sensors for structural health monitoring applications. An insight on the correlation between production process, structural and morphological characteristics and multifunctional properties of the new materials will be provided.

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