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SUSTAINABLE GRAPHENE - BASED NANOCOMPOSITES FOR VEHICLE STRUCTURES

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The automotive industry is widely viewed as being the industry in which the greatest volume of advanced composite materials will be used in the future to produce light vehicles. Nowadays, several advanced materials are widely used in automotive industry. Because of its multifunctional properties and promising applications, many expectations in composite materials are related to graphene. However, no application of graphene-based materials is currently marketed in the automotive sector. Therefore, research activities are under development to study the potentiality of these systems and all the value's chain of automotive needs to be involved in this effort. One of most challenge aims is the economic impact of the innovative structures on the vehicle market, all the value's chain must address their effort to get the final cost of the innovative products as low as possible. The present initiative provides a summary overview on graphene related materials (GRMs) for automotive applications and investigates efficient ways to integrate graphene as polymer reinforcements within composite materials for energy-efficient and safe vehicles (EESVs). The idea is based on the concept-oriented lightweight design aiming of combination of light structures with novel multifunctional materials. For such a purpose, GRMs are addressed with respect to some challenging factors, for instance the large-scale production of graphene or the non-existence of constitutive material models for high performance structural applications like crashworthiness. Therefore, accurate material models need to be developed to support simulation of structural design for these vehicles. A focus on the hierarchical modelling of GRMs with an emphasis on the multiscale constitutive behaviors of each material phase is elaborated in the framework of the graphene flagship to well understand such limitations for a full applicability of graphene. It is anticipated that this initiative will advance innovative lightweight graphene nanocomposites and their related modelling, designing, manufacturing, and joining capabilities suitable for automotive industry which requires unique levels of affordability, mechanical performance, green environmental impact and energy efficiency. This leads to complete understanding of the new graphene nanocomposites and their applicability in high-volume production scenarios.

SPIN NANO-DIODES BASED ON DOPED HEXAGONAL BN

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Recent advances in the synthesis and characterization of h-BN monolayers offer opportunities to tailor their electronic properties via aliovalent substitutions in the two-dimensional lattice. In this talk, we present a h-BN monolayer doped with Si, C or Ge, and show that dopants modify the Fermi level of the pristine h-BN monolayer. Three-fold coordinated dopants relax to the convex-shaped structures, while four-fold coordinated ones retain the planar structures. The doped structures can be readily characterized using the STM imaging technique. The modifications, in turn, lead to unique features in the electron transport characteristics including significant enhancement of current at the dopant site, diode-like asymmetric current–voltage response, and spin-dependent current. We also show that the spin-polarized transport properties of the doped BN monolayers could be used for the next-generation devices at the nanoscale.