Production of graphene-based composite nanostructures through the growth of ZnO nanorods and microrods suspensions onto unsupported GNPs.

KEYWORDS

- NANOMATERIALS
- NANOSTRUCTURES
- GRAPHENE
- ZINC OXIDE
- DOPING

AREA

- NANOTECHNOLOGIES & MATERIALS

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Patent Type
Patent for invention.

Ownership
Sapienza University of Rome 100%.

Inventors
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Industrial & Commercial Reference
Companies involved in the production of nanostructures and nanopowders, production of catalysts, energy harvesting devices, antimicrobial materials and coatings.

Time to Market
The production method described in the patent has been developed on the laboratory scale. Time to market can be estimated to vary between 24 and 36 months.

Availability
Cession, Licensing, Research, Develop-ment, Experimentation, Collaboration, Start-up and Spin-off.

Publications

- Chandraiahgari, C.R., De Bellis, G., Sarto, F., Sarto, M.S. et al. *Control of the size and density of ZnO-nanorods grown onto graphene nanoplatelets in aqueous suspensions* (2016) RSC Advances, 6 (86), pp. 83217-83225. DOI: 10.1039/c6ra18317d

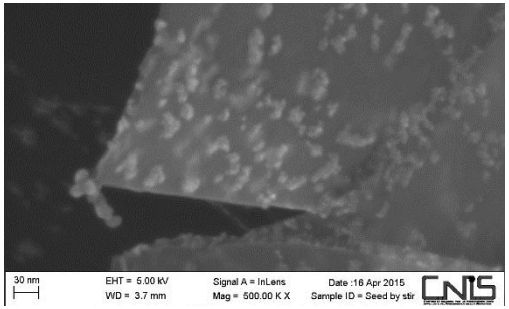

Fig. 1 SEM micrograph of GNPs coated with seed layer obtained by magnetic stirring at 500000 magnification

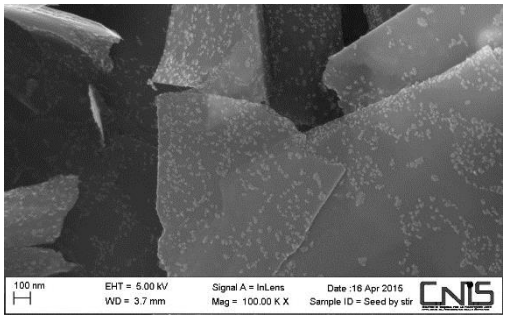

Fig. 2 SEM micrograph of GNPs coated with seed layer obtained by magnetic stirring at 100000 magnification

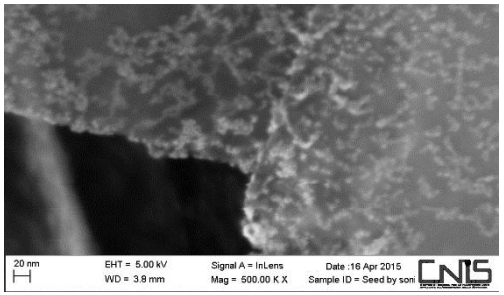

Fig. 3 SEM micrograph of GNPs coated with seed layer obtained by probe sonication at 500000 magnification.

Abstract
The present invention describes a method for the production of graphene nanoplatelets (GNPs) decorated with zinc oxide (ZnO) nanorods.

The developed method allows a uniform decoration of the graphene platelets on both sides of the flakes, along with the control of ZnO nano/microstructures' size and the coating density over GNPs. Such newly developed graphene-ZnO nanostructures possess better physical, chemical, mechanical and electrical properties over non-functionalized GNPs.

The production method is cheap, eco compatible, being developed on a water-based process, and scalable for mass production.
Such novel nan/microstructures, consisting of nano/micropowders, can be delivered in both the dry state and in liquid suspension, using different types of solvents.

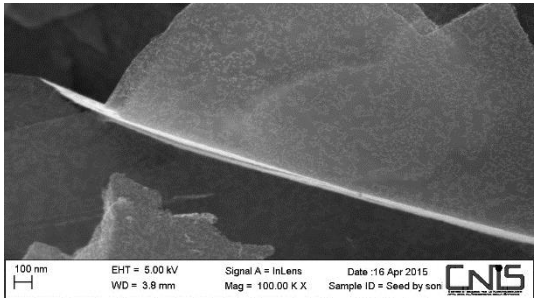

Fig. 4 SEM micrograph of GNPs coated with seed layer obtained by probe sonication at 100000 magnification.

Production of graphene-based composite nanostructures through the growth of ZnO nanorods and microrods suspensions onto unsupported GNPs.

Technical Description

The present invention describes a method for the production of graphene nanoplatelets (GNPs) decorated with zinc oxide (ZnO) nano/microrods.

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Such novel nan/microstructures, consisting of nano/micropowders, can be delivered in both the dry state and in liquid suspension, using different types of solvents.

A methods for the decoration of graphene nanoplatelets with ZnO nano/microrods doped with mono or divalent metallic ions is also reported.

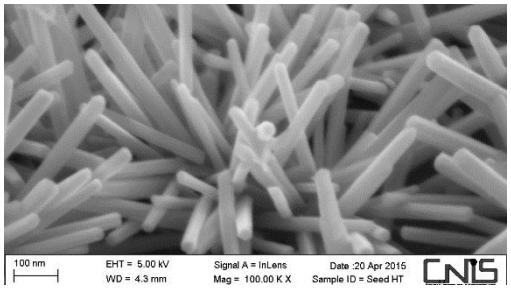

Fig. 5 SEM micrograph of GNPs coated with ZnO nanords obtained by hydrothermal growth under dynamic conditions at 100000 magnification.

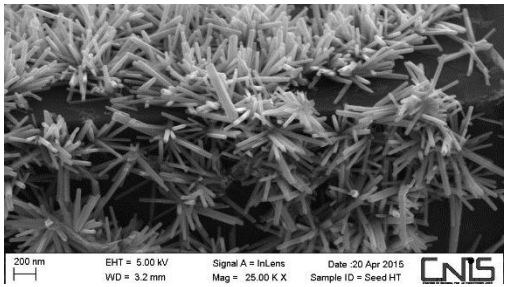

Fig. 6 SEM micrograph of GNPs coated with ZnO nanords obtained by hydrothermal growth under dynamic conditions at 50000 magnification.

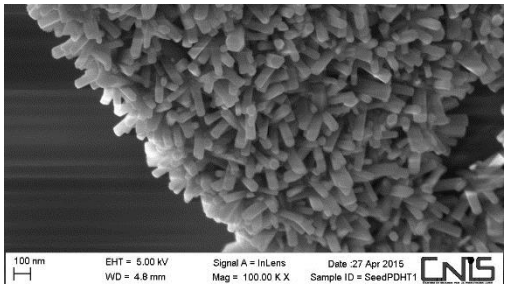

Fig. 7 SEM micrograph of GNPs coated with ZnO nanords obtained by hydrothermal growth under dynamic conditions and seed layer deposited by probe sonication at 100000 magnification.

Technologies & Advantages

Since 2014 we have been developing low cost and low environmental impact ZnO production techniques, suitable for mass production.

In particular, we have been producing ZnO nanorods and nanowires having diameters of tens of nanometers and lengths up to several microns.
Such zinc oxide-based materials show complementary properties to graphene-based nanostructure.

Therefore, with the aim of combining properties and features of the two types of nanostructure, in the present invention we have developed a production route leading to GNPs decorated with ZnO nanorods.
Such coating enhances the dispersion of GNPs into polar liquids, by preventing reaggregation.

Applications

ZnO-coated GNPs could be employed as nanofillers into polymer-based composites, in order to increase several properties, such as: electromagnetic properties for radar absorbing materials, electroactive response for applications in energy harvesting, antimicrobial properties for application in liquid suspensions/antimicrobial materials, photocatalytic activity for energy conversion.

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