

Properties of Metal Nanoparticles (Optical Properties; Electrical Properties; Electromagnetic Properties)

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- **Abstract:**

- Note: These nanoparticles have wide applications in various fields such as optical, electrochemical, electronic and catalytic applications. To improve their properties, metal nanoparticles are combined with other materials, one of the most important of which is graphene and its derivatives.

- **Keywords:** Nanostructure , nanomaterials , amplitude of oscillation , nanoelectronic

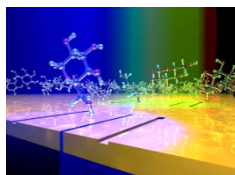
Introduction •

When nanoparticles are composited with graphene or graphene derivatives, they exhibit extraordinary catalytic activity. The surface of metal nanoparticles is considered as catalytic sites. Controlling the particle size has a significant effect on the properties of nanoparticles. The smaller the size of the nanoparticles, the greater the active surface area of the catalyst and the better the performance of the catalyst.

Electrical properties of metal nanoparticles

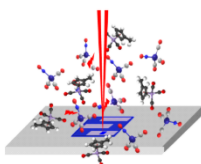
One of the most important properties of metal nanoparticles is their electronic properties. Metal nanoparticles are semiconductors with zero band gap and high electrical conductivity . As we

know, each carbon atom has 1 electron that participates in chemical bonds, but in graphene, each carbon atom is connected to 9 other carbon atoms in a two-dimensional space. The remaining single atoms create p orbitals at the top and bottom of the graphene plane, and these orbitals create carbon-carbon double bonds. The electronic properties are imposed on graphene by (bonding orbitals) and (antibonding orbitals) of double bonds. Graphene shows very high electron mobility at ambient temperature.



Optical properties of metal nanoparticles

The optical strength of metal nanoparticles is 22 mN, the breaking strength is 12, and its Young's modulus is 4 Tpa. Despite its high hardness and strength, it is very light and its density is (1.77 ml/mg). The (optical) properties of the monolayer membrane of metal nanoparticles are measured by the AFM technique.



Electromagnetic properties of metal nanoparticles

Electromagnetic nanoparticles are particles less than 100 nm in size that exhibit nanoelectromagnetic properties in the presence of an external magnetic field. The simplest structure of nanoparticles consists of a magnetic core (such as iron oxide, nickel, and cobalt) and various non-magnetic coatings of chemical compounds that are of interest for some biological applications. For these applications, the particles must have high electromagnetic saturation properties and biocompatibility and simultaneously have the ability to perform various functions. The surface of these particles is modified with a number of organic polymer layers or inorganic metals (such as gold) or oxide surfaces (such as silica and alumina) to be functionalized by the attachment of various bioactive molecules. Magnetic nanoparticles can play an important role as carriers of electromagnetic energy.

References : •

- Review of: \nanodipole L/d is significantly reduced, it cannot be used". (2024).
 Qeios. <https://doi.org/10.32388/y5s2db>
<https://doi.org/10.32388/y5s2db>
<https://doi.org/10.32388/y5s2db>
<https://doi.org/10.32388/y5s2db>
<https://doi.org/10.32388/y5s2db>
 \Application of Nano Wires Nano Wire by Electron Nano Lithography".
 (2023). Qeios. <https://doi.org/10.32388/l3md1n>
<https://doi.org/10.32388/l3md1n>
<https://doi.org/10.32388/l3md1n>

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Review of: \The concept of (Nano assembler)". (2023). Qeios. [https](https://doi.org/10.32388/xrrt0e) HYPERLINK
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Review of: \The degree of order and dimensions of nanowires produced using templates". (2023). Qeios. [https](https://doi.org/10.32388/7siu3m) HYPERLINK
["https://doi.org/10.32388/7siu3m"](https://doi.org/10.32388/7siu3m):: HYPERLINK
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Review of: \It has been done in the manufacture of nanowires through regular one-dimensional arrays with the help of different physical and chemical methods".

(2023). Qeios. <https://doi.org/10.32388/pg9m4tReview>://
[HYPERLINK "https://doi.org/10.32388/pg9m4tReview"](https://doi.org/10.32388/pg9m4tReview) HYPERLINK
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["https://doi.org/10.32388/pg9m4tReview"](https://doi.org/10.32388/pg9m4tReview) tReview

Review of: \Tubular nanotransistors (3D) Very high electron mobility in graphene". (2023). Qeios. <https://doi.org/10.32388/ik4l3i>

Review of: \Nano-Electronics - Plasmonic Technology) in the design of nano-devices such as nano-transistors and nano-diodes, nano-switches and nano-logic gates". (2023). Qeios. <https://doi.org/10.32388/7pndul>://
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