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Eureka Journal of Physical and Chemical Research (EJPCR)

ISSN 2760-490X (Online) Volume 2, Issue 8, August 2026
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ECO-FRIENDLY PREPARATION OF SLIVER \ IRON OXIDE NANOCOMPOSITE USING HIBISCUS EXTRACT

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Abstract

Through this work, the nanocomposite silver \ iron oxide (85:15) was prepared in an environmentally friendly way using the plant extract (hibiscus leaves), as these extracts are safe, environmentally friendly, inexpensive and highly efficient. they also contain reducing agents that reduce chemicals and convert them into nanoparticles that can be used in various applications, such as removing pollutants from water, communications, energy storage, sensors, date storage, cosmetics, thin films, solar cells, Nano electrodes and photo reduction due to its optical electrical and magnetic importance.

Keywords: Nanocomposite, Eco-Friendly, Biosynthesis, Reducing agents.

Introduction

Nanotechnology is a rapidly evolving field attracting researchers from diverse scientific disciplines, centering on the study of nanoparticles (NPs) with diameters ranging from 1 to 100 nanometers. These particles possess unique characteristics—such as small size, a high surface-area-to-volume ratio, and structural diversity—making them suitable for applications in environmental science, medicine, and agriculture. They appear in various forms, including nanocrystals, nanoflowers, nanotubes, and nanowires. However, conventional

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synthesis methods are energy-intensive and rely on toxic materials, necessitating the search for more sustainable alternatives.[1] Metal nanoparticles (MO-NPs) hold a prominent position among the various categories of nanoparticles (NPs), primarily due to their eco-friendly nature and their extensive contributions to diverse fields such as environmental management, agriculture, and nanomedicine. Amidst this growing interest, scientists are focusing increasingly on the biosynthesis of these particles—utilizing metals such as zinc, iron, silver, platinum, and gold—to harness them for applications ranging from mineral degradation and medical and pharmaceutical products to everyday consumer goods like shampoo, soap, toothpaste, detergents, and cosmetics.[1] This growing trend toward biomanufacturing methods reflects a deep understanding of the potential these particles hold for achieving environmental sustainability without compromising their high efficiency. In this context, the study highlights the synthesis of Fe2O3 nanoparticles using a green, cost-effective approach that avoids toxic chemicals and minimizes energy consumption. These particles underwent comprehensive and precise characterization using advanced analytical techniques—including SEM, EDX, DLS, FTIR, and UV-Vis—to elucidate their morphological characteristics, surface chemistry, and optical properties.[1] In terms of applications, this study offers a comprehensive assessment that transcends the scope of conventional research; the nanoparticles demonstrated significant efficacy across a wide range of pharmacological areas—most notably their antioxidant, anti-inflammatory, anti-leishmanial, anti-diabetic, and antimicrobial properties, alongside their biocompatibility and potential to inhibit protein kinase as an anti-cancer agent. These findings highlight the synergistic role of phytochemicals in enhancing nanoparticle stability and amplifying therapeutic effects, making this research

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a significant contribution that bridges "green synthesis" with broad biomedical applications and paves the way for future studies in nanopharmacology.[1] Nanoparticles are characterized by their high customizability to meet the requirements of specific applications, as they can be adapted with various materials to acquire specific properties; they have proven their worth in numerous scientific and technical applications. Magnetic nanocomposites hold a pivotal position in this context, commanding the lion's share of research and study regarding their design, synthesis, and production.[2]

What perhaps gives these compounds their exceptional value is their possession of a suite of complementary properties—including high saturation magnetization, remarkable biocompatibility, low toxicity, and high stability, alongside ease of separation, cost-effectiveness, and efficient signal detection. Collectively, these advantages have expanded the scope of their applications across diverse scientific fields. The core concept underlying the design of these compounds is the integration of magnetic properties with the unique characteristics of specific materials to achieve the desired objectives.[2] What perhaps gives these compounds their exceptional value is their possession of a suite of complementary properties—including high saturation magnetization, remarkable biocompatibility, low toxicity, and high stability, alongside ease of separation, cost-effectiveness, and efficient signal detection. Collectively, these advantages have expanded the scope of their applications across diverse scientific fields. The core concept underlying the design of these compounds is the integration of magnetic properties with the unique characteristics of specific materials to achieve the desired objectives.[2] Silver nanoparticles (Ag-NPs) have garnered significant research interest, primarily due to their distinctive optical properties and remarkable antimicrobial

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capabilities. Furthermore, their high surface area and high surface energy render them highly effective materials for photocatalysis and absorption applications.[3]

A key physical characteristic of these particles is the surface plasmon resonance (SPR) phenomenon, which arises from the resonant oscillation of free conduction electrons at the nanoparticle interface. This phenomenon has significant implications, leading to a marked increase in both optical absorption and light scattering efficiencies. This SPR property has become a cornerstone of advanced biosensing and chemical sensing, making silver nanoparticles a pivotal element in the development of new generations of highly sensitive, precision sensors.[3] Nanofabrication processes occupy a pivotal position within the nanotechnology ecosystem, enabling the production of diverse functional devices that serve a wide spectrum of applications. In this context, two primary manufacturing approaches compete, differing in their underlying principles, methodologies, and outcomes. The first approach—known as "top-down"—offers a high degree of precision but entails significant practical limitations; its procedures are characterized by multiple steps, complexity, high costs, and operational burdens. In contrast, the second approach—based on the "bottom-up" principle—relies on[4] wet-chemical methods for nanostructure fabrication; however, it suffers from limited control over the spatial precision of the manufactured structures, representing a fundamental drawback.

Amidst the competition between these two approaches, "photoprinting" has recently emerged as a promising alternative based on the bottom-up fabrication principle. It leverages colloidal chemistry to produce nanostructures characterized by high spatial precision, tunable properties, and multifunctionality. Although its spatial resolution remains constrained by the

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optical diffraction limit, the technique offers a range of practical advantages—including ease of processing, on-demand printing, minimal material waste, and the ability to directly fabricate active structures—making it a technology with broad application potential spanning electronics, sensors, and healthcare devices.[4]

Nanomaterial it is that distinguished category of advanced and very small materials that are prepared in laboratories or that already exist in nature and whose internal particle dimensions range between 10-100 nanometers. Reducing the sizes and dimensions of these materials has led to them behaving differently from traditional large-sized materials whose dimension exceed 100 nanometers, as it gives them very distinct qualities and characteristics that are not found together in those traditional materials [5]. Therefore, nanotechnology has become at the forefront of the most important and exciting fields in physics, chemistry, biology, engineering and many other fides and it has given great hope for the emergence of scientific revolution in the near future. [6]. Nanoparticles have several properties including (1) Mechanical properties: the mechanical properties of the material come at the top of the properties that benefit from the small size of grains as their hardness increases and their resistance to stress and loads placed on them increases in addition to gaining more durability. they have begun to be used in the manufacture of tools and cutting and drilling tools used in cutting very hard objects. (2) chemical activity: the chemical activity of nanomaterials increases due to the presence of large numbers of atoms of the material on their outer surfaces, where they work. as catalysts they react vigorously with toxic gases. Which makes it a candidate to play the most important role in reducing environment pollution. Fuel cells are also one of the low -cost applications of Nano catalysts and one of the most important sources of new and clean energy.

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(3) Magnetic properties: the smaller grains of material and the more atoms on their outer surfaces, the stronger and more effective their magnetic ability becomes which enables us to use them in large electrical generators, ship engines and the manufacture of high - precision analysis devices and magnetic resonance imaging. (4) Electric properties: reducing the size of the materials grains to less than 100 nanometers increase their ability to conduct electrical current, which enables these materials to be used in the manufacture of micro-sensors and electronic chips [7]. nanoparticles play an important role in industries and various fields including sensors, electronics, ceramics, metal coatings, hydrogen production, biocides and pesticides, as they work to stop the growth of microorganisms and algae, and in photo catalysis, as these compounds work to enhance the activity of photo catalysis by expanding the response range and increasing the efficiency of electron pair separation [8,9].

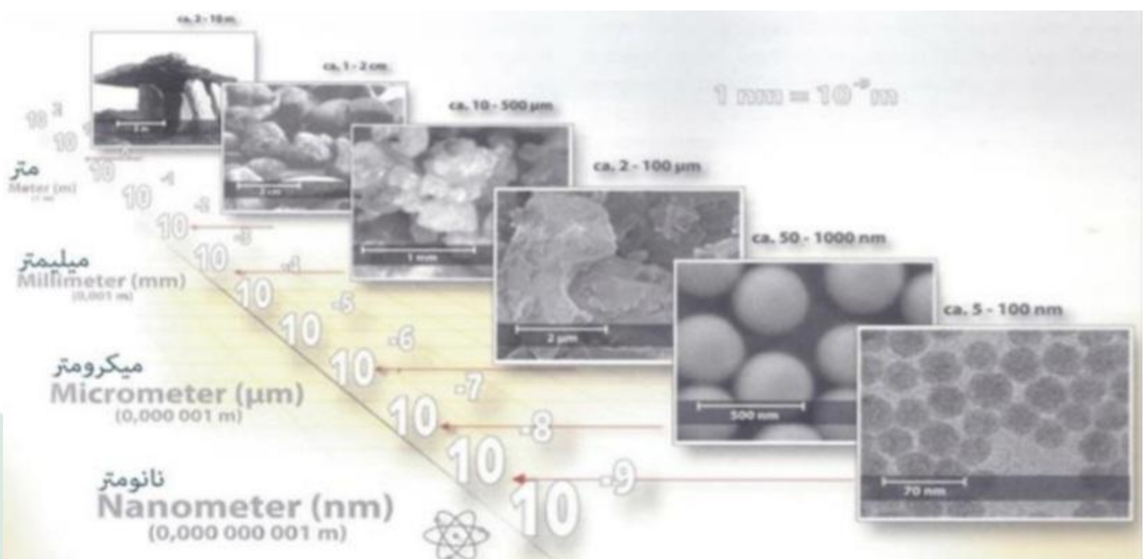

Figure (1-1) Nanoscale from meter to nanometer [5]

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Materials and Methods

Chemicals

Sliver nitrate ($AgNO_3$) purity 99.9% , its molecular weight is 169.87 g\mol , its density is 4.35 g\$cm^3$, iron nitrate $Fe(NO_3)_3.9H_2O$ purity 99 % , its molecular weight is 404 g\mol , its density is 1.68 g\$cm^3$ were Purchased from Sigma Aldrich, hibiscus plants, Filer paper, absolute ethanol was buy from Merck (KGaA, Germany) and (DDW) is used the work.

Instruments

X – ray diffraction (Xrd – 6000 Japan), Scanning electron microscope (FE-SEM), (JEOL JSM-6515L V Japan), Furnace (K – MFO3 K&K Scientific, Korea), Ultrasound path (405 power sonic, Hwashin, koura), Hot plate stirrer (KMS-1003 Labtech, Korea).

Preparation of extract

prepared hibiscus extract by collected dried plants were carefully washed with distilled water and dried in air. Then, the dried plants were divided into short parts (250) g adding 2L of deionized water. Then heating at 60 °C for 15 minutes at room temperature, then prepared extract was filtered using whatman filter paper [10].

Synthesis of Sliver \ Iron Oxide nanoparticles

Sliver \ iron oxide nanoparticles were prepared by adding (0.23) g from sliver nitrate ($AgNO_3$), with (6.14) g from iron nitrate Fe($NO_3)_3.9H_2O$ into (50) ml from hibiscus extract which was previously prepared and left at room temperature until color changed to brown. Indicating the formation of nanoparticles of sliver \ Iron oxide.

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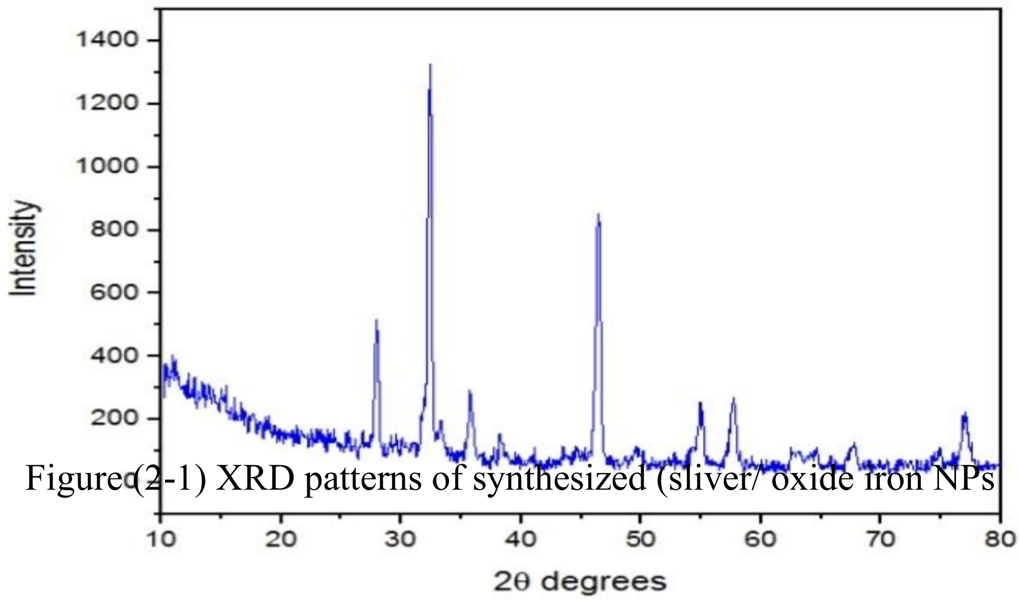
Result and discussion

X – ray Diffraction pattern (XRD)

X -ray diffraction technique is used to study the microstructure and know the crystal structure of the material [11]. The analysis results of the prepared nanocomposite sliver \ iron oxide showed the formation of sharp, narrow peaks, with high crystallinity and density [12].



Figure(2-1) XRD patterns of synthesized (sliver/ oxide iron NPs

Field Emission - Scanning Electron Microscopy (FE-SEM)

The surface morphology of the silver / iron oxide nanocomposite was analyzed by scanning electron microscopy. The results showed that the nanoparticles appeared in the form of small, disorganized and heterogeneous spherical masses. And some of them appeared in the form of smooth tube and their face could be distinguished on the surface of the structure [13,14 ,15].

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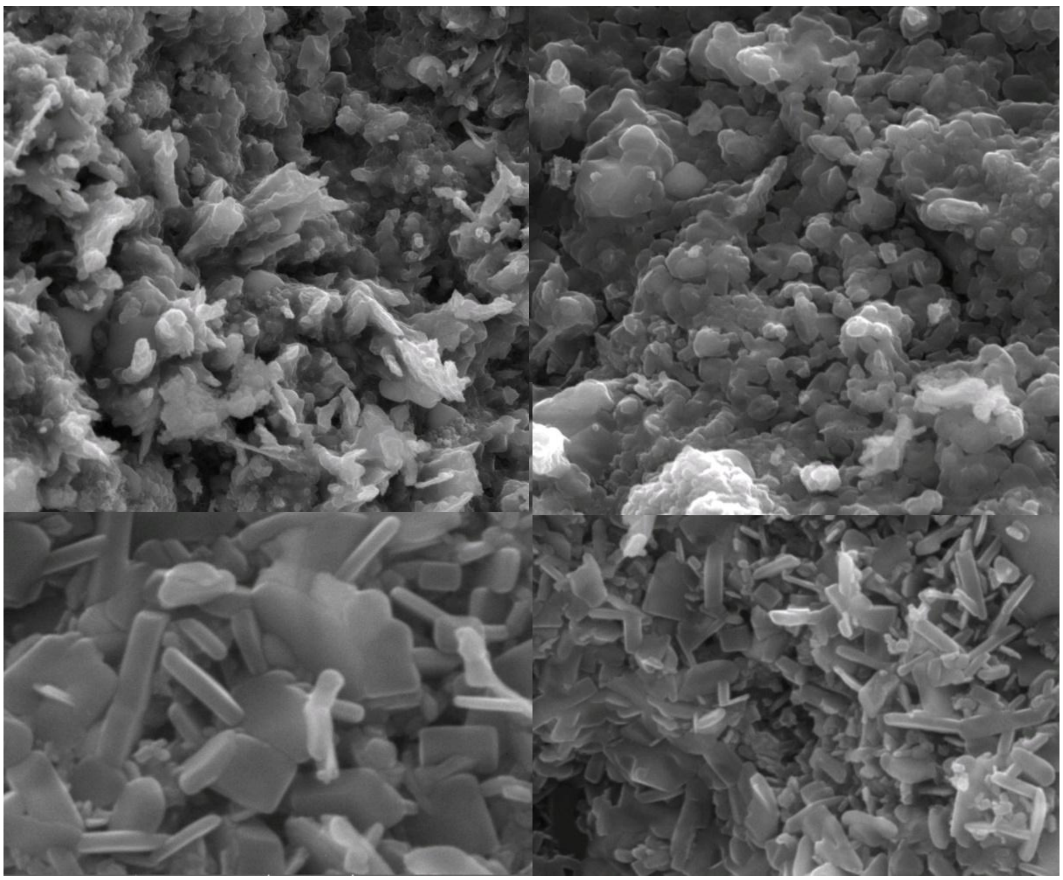

Figure (3-1) FE-SEM images of synthesized (sliver/iron oxide NPs)

References:

[1]- Kamal, A., Nazish, M., Kamal, K., Abdelmohsen, S. A., Alarfj, S. F., Rebouh, N. Y., ... & Zaman, W. (2026). Fagonia indica mediated biosynthesis of iron oxide nanoparticles with enhanced antimicrobial and therapeutic potential. Discover Nano, 21(1), 201.

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[2]- Rabbi, M. A., Akter, M. B., Chaki, B. M., Latif, M. A., Al-Amin, M., Rasel, M. Z. U., ... & Habib, M. R. (2024). Preparation of stable Fe 2 O 3/Ag nanocomposite particles with catalytic, antioxidant and antibacterial properties. New Journal of Chemistry, 48(12), 5278-5288.

[3]- Trang, V. T., Tam, L. T., Phan, V. N., Van Quy, N., Huy, T. Q., & Le, A. T. (2017). Two-step hydrothermal synthesis of bifunctional hematite–silver heterodimer nanoparticles for potential antibacterial and anticancer applications. Journal of Electronic Materials, 46(6), 3323-3332.

[4]- Bannur, B., Kolikkaje, M., Shivalingegowda, S. M., & George, S. D. (2025). White light-assisted projection printing of submicron plasmonic nanostructures for advanced nanofabrication. Materials Horizons, 12(13), 4875-4883.

[5] - Balfar, & Kodia. Biomanugfacturing of some nanoparticles and their applications in removing lead and methyl orange from polluted water (Doctoral dissertation, University of Kasdi Merban, Ouargla).

[6] - Naami, Khawla, Azri & Ramisaa, A. theoretical study on the application of nanomaterials in water treatment, university of Kasdi Merbah, Ouargla.

[7] - Shenawa, Washington (2017). The role of different materials in reclassifying the costs of modern industrial products. journal of the city of world University College, 9(2), 149-176.

[8] - Wei, A., Xiong, L., Sun, L., Liu, Y. J., & Li, W. W. (2013). CuO nanoparticle modified ZnO nanorods with improved photocatalytic activity. *Chinese Physics Letters*, *30*(4), 046202.

[9] Bondarenko, O., Juganson, K., Ivask, A., Kasemets, K., Mortimer, M., & Kahru, A. (2013). Toxicity of Ag, CuO and ZnO nanoparticles to selected environmentally relevant test organisms and mammalian cells in vitro: a critical review. *Archives of toxicology*, *87*(7), 1181-1200..

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[10] - Ahmad, T., Phul, R., Khatoon, N., & Sardar, M. (2017). Antibacterial efficacy of Ocimum sanctum leaf extract-treated iron oxide nanoparticles. *New Journal of Chemistry*, *41*(5), 2055-2061..

[11] - Kumar, M., Ranjan, R., Dandapat, S., Srivastava, R., & Sinha, M. P. (2022). XRD analysis for characterization of green nanoparticles: a mini review. Manoj Kumar, Rakesh Ranjan, Sukuma Dandapat, Rohit Srivastava, Manoranjan Prasad Sinha (2022). XRD Analysis for Characterization of Green Nanoparticles: A Mini Review. Global Journal of pharmacy and pharmaceutical Sciences, 10(1), 555779.

[12] - Herrrera Sandoval, G. M. (2013). Synthesis of nanoparticles of iron oxide, silver and gold for photodegradation and detection of 2,4,6-trinitrotoluene.

[13] - Saeed, M., Usman, M., Muneer, M., Akram, N., ulhaq, A., Tariq, M., & Akram, F. (2020). Synthesis of Ag-Fe3O4 nanoparticles for degradation of methylene blue in aqueous medium. Bulletin of the Chemical Society of Ethiopia, 34(1), 123-134.

[14] - Gai, K., Qi, H., Zhu, X., & Wang, M. (2019). Preparation of Ag-Fe3O4 nanoparticles sensor and application in detection of methomyl. In E3S Web of Con ferences (Vol. 118, P.01002). EDP Sciences.

[15] - Kareem, Z. H. Shareef, H. K., & Alkaim, A. F. (2018). Evaluation of antibacterial activity of Fe ^ sub 2^ O^ sub 3^ nanoparticles against Shigella dysenteriae. Journal of pharmaceutical Sciences and Research, 10(8), 1980-1982.