



Green synthesis of iron oxide nanoparticles by aqueous leaves extract of *Mentha Pulegium* L.: Effect of ferric chloride concentration on the type of product

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Abstract

In this study, green synthesis of iron oxide nanoparticles was successfully prepared from *Mentha pulegium* L. leaves extract. The effect of different ferric chloride concentrations on the nanoparticles' iron oxide formation was studied. The obtained nanoparticles were characterized by UV-Vis, FT-IR, XRD, SEM and EDAX techniques are used for this purpose. UV-Vis spectra showed maximum absorption at range 275–301 nm related to the iron oxide. FTIR spectra exhibit a two weak peak at 510 and 594 cm⁻¹ attributed to iron oxide NPs vibration, confirming the formation nanoparticles XRD confirmed the crystalline nature of Fe₃O₄ and α-Fe₂O₃ NPs with average size ranged in 22–34 nm. SEM showed that the green synthesizing Iron oxide nanoparticles having in general as cubical shape. As a result, the use of *Mentha pulegium* L. leaves extract offers its ease, fast, low cost and friendly to the environment compared to other methods.

Graphical abstract



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Introduction

As a result of the terrible environmental pollution that has hit the world, green technology and chemistry have become more common and used.

Green synthesis is an advance over physical and chemical methods because it is environmentally friendly and easy to implement for large-scale synthesis. This method does not require the use of high pressure, temperature, energy and a toxic chemical [1].

In recent years, the interest in ferrous nanomaterials (IONPs) has increased due to its very diverse properties, high catalytic activities and high intrinsic interactivity of its surface sites with great interest from researchers in various fields.

Iron oxides are available in nature and can be easily synthesized in the laboratory. There are about 16 forms of iron oxides, including hydroxides, oxides, and hydroxides. Oxidation and reduction behavior Linked to PH and implements the water interactions between the minerals. The crystal clamps and valence are different only, otherwise, the general constitution of Fe, O, and/or OH is similar.

Section snippets

Preparation of the leaf extract

Leaves of *Mentha pulegium* L. were collected from local fields in the region of El Oued (Southeast of Algeria). Fresh leaves were washed and dried in a shade at room temperature for 5–7 days, and then crushed to obtain a fine powder, The plant material was extracted by the maceration method. The extract was prepared by putting 10g of powder's leaves with 100ml of distilled water in a 250ml glass beaker. The mixture was stirred steadily for 24h at room temperature. The extract was filtered...

Results and discussion

The UV–Vis spectra of iron oxide nanoparticles synthesized using a *Mentha pulegium* L. leaf extract are shown in Fig. 1. As can be seen from this figure, one peaks of maximum absorption are exhibited. The absorption peak at 275–301 nm gives a clue that iron oxide nanoparticles may be formed [8], [9].

The estimated optical band gap (E_g) of iron oxide nanoparticles can be determined by extrapolation from the absorption edge which is given using Tauc's relation Eq. (1) [10], [11]: $(\alpha h\nu)^2 = A(h\nu - E_g)$ where $\alpha...$

Conclusion

Iron oxide has been successfully prepared by a simple approach. The prepared iron oxide product has a cubical structure and narrow band gap, which could effectively absorb visible light and might have potential applications in a photocatalyst. Results showed the variation of the molar amount of Fe precursor allows us to strictly control the size and shape of the iron oxide, which is suitable for large scale production....

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper....

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