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Magnetite nanoparticles coated with chitosan and poly (acrylic acid) blends for biomedical applications

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Plan of presentation

- Magnetic nanoparticles,
- Poly(acrylic acid) and chitosan,
- FTIR Spectroscopy,
- TEM Analysis,
- XRD Analysis,
- Conclusion.

Magnetic nanoparticles

In recent years, the synthesis and characterization of nanoparticles has been the focus of intensive research. Particularly interesting are biochemically functionalized nanoparticles which can be used in many various biomedical applications.

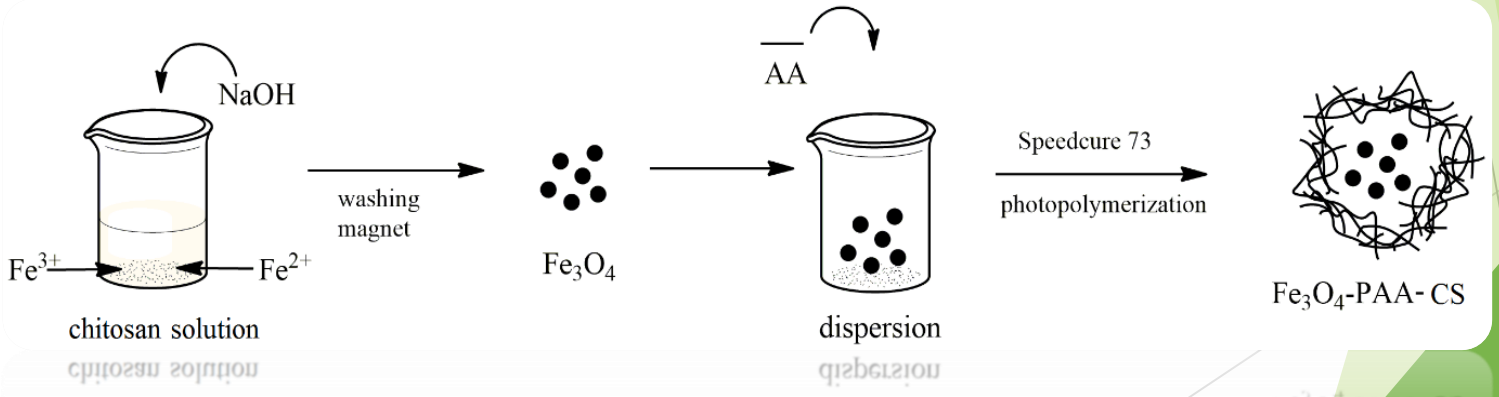


Fig. 1. The scheme of preparation of Fe_3O_4-PAA nanoparticles.

Poly(acrylic acid) (PAA)

PAA is a weak polyelectrolyte which can interact with inorganic cations such as iron ions by electrostatic interactions and form coordination compounds with iron oxides. PAA is characterized by the ability to absorb a large quantities of water, so it is used as a superabsorbent.

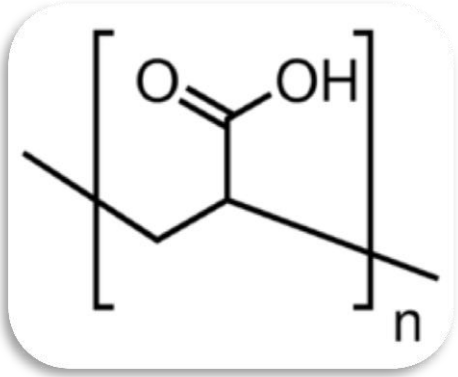


Fig. 2. Structure of poly(acrylic acid).

Chitosan

Chitosan is a product obtained by partial deacetylation of chitine in alkaline conditions. It is polycationic polymer with a specific structure and properties. Its biocompatibility and biodegradability.

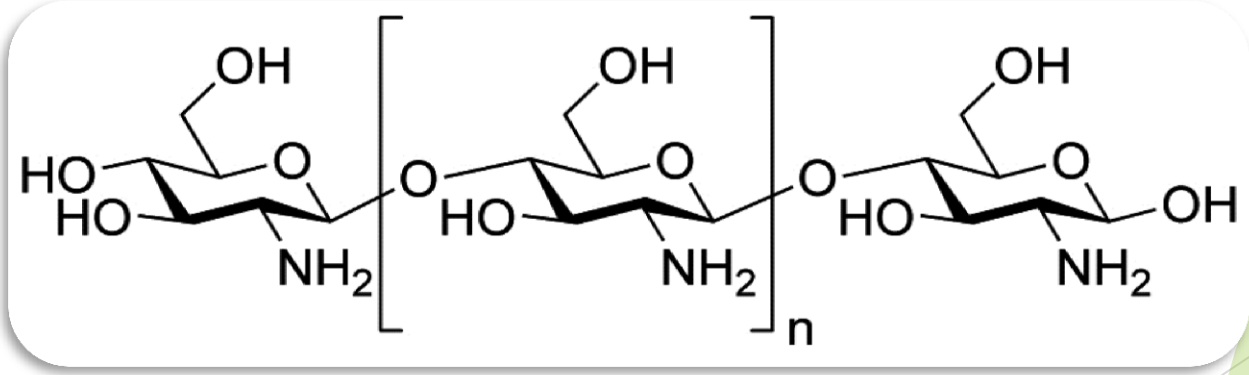
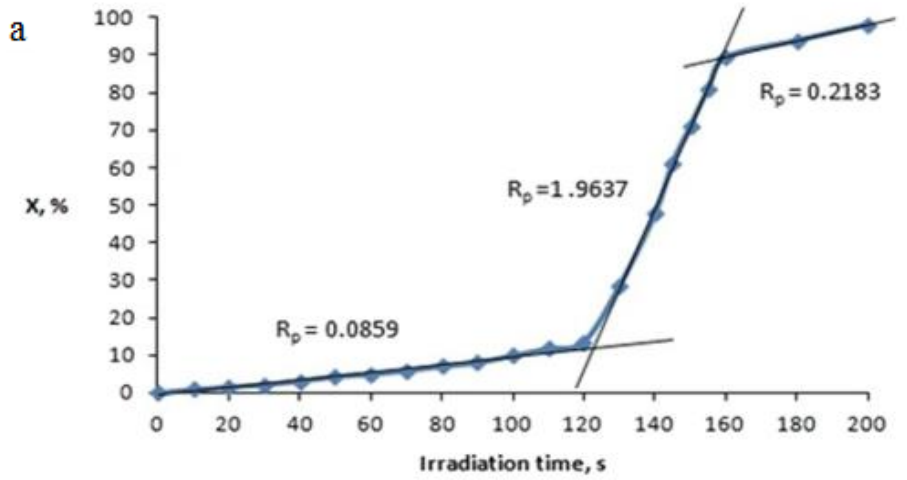


Fig. 3. Structure of chitosan.

FTIR Spectroscopy

The band at 1635 cm^{-1}, corresponding to the C=C vibrations, has been selected for the analysis and calculation of conversion degree of monomer (X,%).



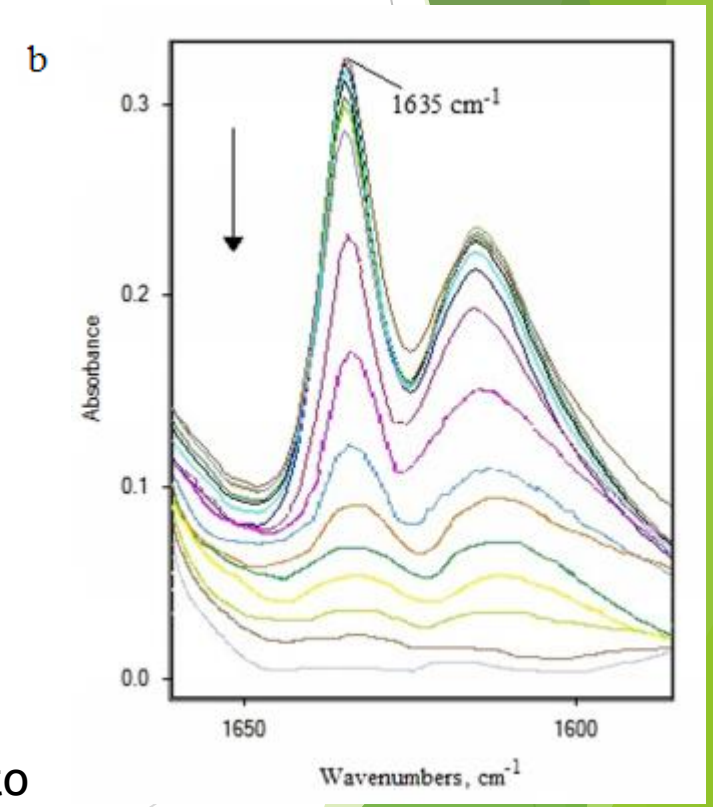


Fig. 4. (a) The kinetics of acrylic acid photopolymerization in air atmosphere; **(b)** The changes of absorption band corresponding to the C=C stretching vibrations.

TEM Analysis

The morphology of magnetite nanoparticles coated with poly(acrylic acid) by photopolymerization has been investigated by HR-TEM. The estimated diameter of the nanomaterials was about 6-13 nm. The resulting nanoparticles are not fully spherical, structures observed in the flat image are rather hexagonal.

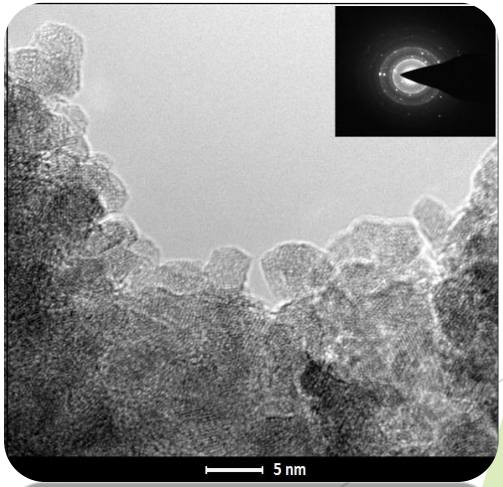


Fig. 5. HR-TEM image of Fe_3O_4-PAA nanoparticles.

XRD Analysis

The XRD analysis shows six characteristic for magnetite signals at 30, 35, 43, 53, 57, and 62° marked by their indices:(2 2 0), (3 1 1), (4 0 0), (4 2 2), (5 1 1),and (4 4 0). These peaks reveal that the nanoparticles core was a pure magnetite of spinel structure and the structure of Fe_3O_4 is not changed during the synthesis process.

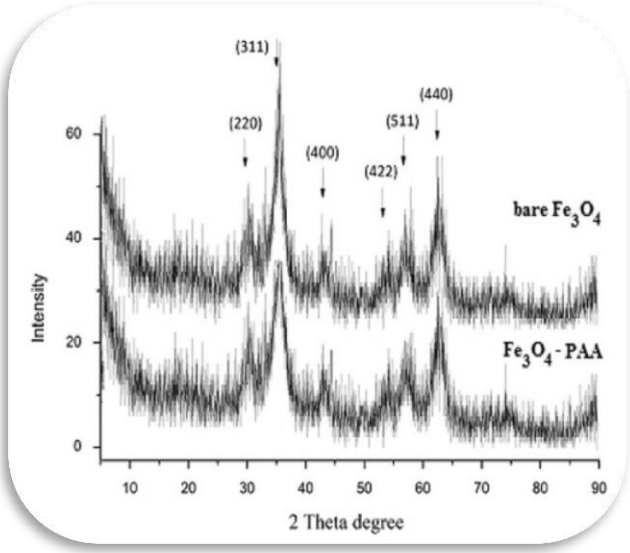


Fig. 6. X-ray diffraction pattern of Fe_3O_4-PAA nanoparticle.

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Conclusion

The simple and fast method of preparation of the magnetite nanoparticles coated with poly(acrylic acid) and chitosan in air atmosphere and at room temperature was presented. The crosslinked coating ensures the stability of magnetite nanoparticles in aqueous solutions. The content of magnetite in the nanoparticles was very high (81%), which is unreachable by any other conventional coating method (e.g., by polymerization at elevated temperature).

Thank you for your attention.

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