MAGNETIC NANOPARTICLES SYNTHESIS FOR DRUG DELIVERY SYSTEMS

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Introduction. Given the rapid pace of development of magnetic nanotechnologies in pharmacy, the establishment of conditions for the synthesis of magnetic nanoparticles of different composition for pharmaceuticals is of actual practical importance. To this end, we consider it expedient to conduct a comprehensive study of the possibilities of the method of chemical condensation as a method of synthesis of oxide nanoparticles of magnets of different composition and structural type.

The method of chemical condensation allows obtain particles in the nanoscale range. In the liquid phase, high dispersion and close contact are achieved; uniform distribution of the components of ferrite particles is ensured. As a result, the synthesis products are characterized by the reproducibility of the chemical composition and properties. Upon on this, method can be successfully used for the synthesis of magnetic components of drugs. In support of this fact, further studies have developed the conditions for the synthesis of ferrites of different structural type and composition by chemical condensation. The synthesized systems of highly dispersed magnetic materials were certified according to the functional parameters of the drug component. Usage of magnetic nanoparticles in the composition of drugs allows obtain magnetically controlled Drugs Delivery Systems (DDS), which innovatively changes the methods of use of the tool, expands the possibilities of local treatment.

Aim. To investigate chemical coprecipitation method for synthesis ferrite particles for DDS with magnetic properties.

Materials and methods. In the experimental work, particles of ferrite various structural types and compositions have been synthesized by chemical condensation method. Based on the results of previous studies, the methodology of the synthesis has been established. The reaction has been conducted by using solutions of the corresponding metal cations (99.99% purity, Aldrich) in an alkaline medium.

Results and discussion. Today design of DDS is the focus of the attention of many researchers. This is confirmed by the extremely high number of publications (Figure) related to the study of magnetic DDS, which has grown 10 times over the past twenty years (analysis of data from the search engine Google Scholar, using keywords “Drug Delivery Systems”).

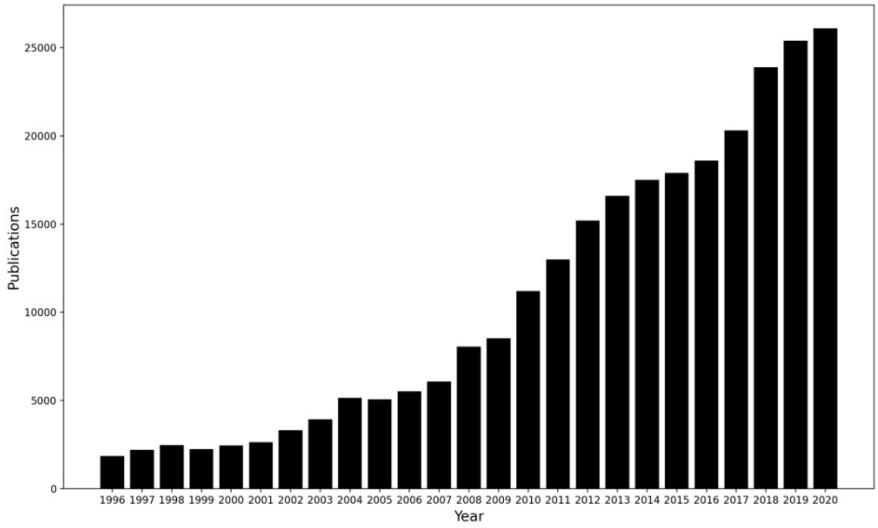

Figure: Diagram of amount of publications(the analysis of database Google Scolar, using keywords “Drug Delivery System”)

In this work, magnetic nanopartcles particles were obtained by coprecipitation of cation (II) and (III) salts in an ammonium hydroxide medium according to the reaction equation:

$$2Fe^{3+} + yFe^{2+} + xMe^{2+} + (6+x+2y)\ OH^- \rightarrow Me_xFe_yFe_2O_4 + (6+x+y)\ H_2O$$

To establish the optimal composition of ferrites, the dependence of the magnetic properties of ferrites of variable composition on the content and nature of divalent cations – substituents was previously theoretically substantiated. Depending on the distribution of divalent and trivalent ions on the lattice, there are normal, inverse and mixed spinel. In the structure of a normal spinel in tetrahedral positions there are divalent ions (one per formula unit), in octahedral positions – other ions. The distribution by cations is as follows:

$Me^{2+}[Fe^{3+}{}_2]O_4$ (octahedral ions are indicated in square brackets).

In the structure of the reverse spinel, divalent ions are located in octahedral positions (one per formula unit), and trivalent ions are equally distributed between octahedra and tetrahedra (one each in positions of a certain type per formula unit) and the distribution by cations is as follows: $Fe^{3+}[Me^{2+}\ Fe^{3+}]O_4$.

Conclusion. Based on the successful experience of using mixed type ferrites in engineering, it should be noted that they are an interesting object of study for their use in pharmacy. The development of methods for the synthesis of mixed ferrites in the nanometer range, the study of their properties is the task of finding new structures with exceptional functional properties, which certainly has both theoretical and practical significance.