БІОЛОГІЧНІ НАУКИ

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APPLICATION OF SUPERPARAMAGNETIC IRON OXIDE NANOPARTICLES

For the solution of dozens medical, biological, physical and technical problems the last years a great success was reached by researchers that deal with nanoparticles. Nanotechnologies may provide the key answers to the questions that retard world on its way to unbelievable achievements in science, and as a result everyday life of a single person. There is a great variety of engineered nanoparticles; among them are metals, quantum dots, nanotubes, which differ on their properties (e. g. magnetic, fluorescent, harmonic properties, etc.) [1]. Researches on combining few different properties in one nanoparticle have the highest potential today.

There are two types of nanoparticles which have magnetic properties: paramagnetic and superparamagnetic. The principal difference is that latter lose its properties when magnetic field is removed [2]. SuperParamagnetic Iron Oxide Nanoparticles (SPIONs) are submicron moieties (diameters ranging from 1 to 100 nm) [3]. If particles reach bigger sizes – superparamagnetic properties disappear.

Practically, iron oxide nanoparticles are not used without inert shell. They are usually covered with a thin layer of silicon oxide, polystyrene or another polymer. This shell prevents the aggregation of nanoparticles, which can have negative consequences, when used *in vivo*.

Such metals as iron, cobalt, nickel and their oxides are usually used for the synthesis of magnetic nanoparticles. The disadvantage of zero-valent metals is their rapid oxidation that significantly decreases magnetic properties. For this reason, ferrites are commonly used (mostly magnetite Fe_3O_4 nanoscale particles and maghemite $\gamma\cdot Fe_2O_3$), which does not have these disadvantages. When certain conditions that provoke reduction of particles size to less than 100 nanometers are created, ferrites obtain superparamagnetic properties [4].

Magnetic properties of SPIONs give the possibility to manage and direct these particles in a certain location and heat it, if needed. This property was useful for delivering drugs in any part of the body, and a relatively small particle size of SPIONs allowed using it for cellular manipulations. Magnetic nanoparticles are of great interest for researchers from a wide range of disciplines, including magnetic fluids, catalysis, biotechnology/biomedicine, magnetic resonance imaging, data storage, and environmental remediation [4].

One of the main functions of SPIONs is addressed delivery of medications. To do this, nano- and microcapsules of a porous structure with built-in into a shell of the capsule magnetic nanoparticles were offered. Under the influence of an alternating magnetic field magnetic particles begin to heat up and reveal the pores in the capsule shell, through which certain amount of drugs is released. According to this principle were held some experiments in which cytotoxic drugs were delivered to malignant tumor cells for local chemotherapy [5].

For carcinoma curing iron oxide nanoparticles are also covered with a shell containing specific ligands to make it possible for receptors of tumor cells to recognize the particles and let them enter the cell, than in the environment of high-frequency electromagnetic fields SPIONs heat and thermally destroy tumor cells [6].

It is possible to sort and manipulate specific cells with the help of magnetic field. For example platelets and apoptotic cells can be sorted. For this aim the surface of synthesized nanoparticles has to be covered with a peptide annexin V, that has a property of specific binding with phosphatidylserine (PS) [7]. The appearance of PS on the outer part of cell membrane can be an indicator signal of apoptosis [8]. Due to this binding it will be possible to remove apoptotic cells from the culture by the action of magnetic field. Also PS was noticed on the surface of activated platelets, so it may be possible to sort the fraction of it for forward aims.

What about already widespread innovative techniques, that are used today it is that iron oxide nanoparticles are used as contrast agents for MRI, for the repairing of damaged tissues, hyperthermia, for spatial manipulation of cells, as biomarkers and detoxificators of the liquids, for immunoassay, etc [9].

The synthesis of magnetic nanoparticles covers a wide variety of compositions and sizes, it has made significant progress, especially in the last years. Surface fictionalization and modification of magnetic nanoparticles to introduce additional functionality gain more and more attention. Multifunctional magnetic nanoparticle systems with designed active sites, including ligands, enzymes, chiral catalysts, drugs, and other species, seem to be promising for a variety of applications [4]. Nobody can say for sure how far can these technologies go, but due to its budding properties and successful results, that have already been obtained it gives scientists an impulse to move on in the development of this study.

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ЗАХІДНИЙ КВІТКОВИЙ ТРИПС (*FRANKLINIELLA OCCIDENTALIS* PERGANDE) КАРАНТИНИЙ ШКІДНИК В УКРАЇНІ

Західний квітковий трипс *Frankliniella occidentalis* Pergande – є представником класу комах, родини трипсів (Thripidae) [1, 2, 7]. В перше даний трипс було виявлено на культурних та дикорослих рослинах в США у штаті Каліфорнія, пізніше квіткового трипса було виявлено на квітках цитрусових у штаті Флорида. З часом *Frankliniella occidentalis* поширилась за межі США і вже у 1983 році трипс потрапив до Європи, де вперше його було виявлено у Голландії. З Голландії трипс дуже швидко поширився й до інших країн з імпортованими до них квітами. У найближчих країн сусідів України, таких як Польща та Угорщина даного шкідника було виявлено у 1987 та 1989 роках відповідно [5, 6]. В самій Україні з 1994 року карантинні служби неодноразово виявляли західного квіткового трипса в імпортованій рослинній продукції [1].

Дорослі самки мають розмір тіла від 1,3 мм до 1,4 мм, самці мають менший розмір – 0,9-1,1 мм. Колір комах може змінюватись від жовтого до коричневого, залежно від кліматичних умов [1, 2].

Самки трипса мають пиловидний яйцеклад, яким вони роблять надрізи у паренхімних тканинах листків, квіток і плодів, куди ці комахи відкладають ниркоподібні матові яйця [1, 2].

Личинки, які щойно вилупились мають білий скловидний колір, потім жовтіють. Личинки подібні до дорослих комах, однак вони безкрилі, мають червоне забарвлення очей і антени складаються з декількох члеників. Личинки 2-го віку після линьки стають активнішими, починають інтенсивніше живитись і до завершення даної стадії розвитку швидко збільшується у розмірах. У цій фазі личинка набуває жовтовоскового кольору, чітко проявляється рух від суцвіть або рослин до поверхні грунту. У грунті на глибині 1,5-2 см личинка