



OPIS PREDMETA / SUBJECT SPECIFICATION

Predmet:	Nanodelci v biomedicini
Subject Title:	Nanoparticles in biomedicine

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Podiplomski študijski program Post graduate education program	Biomedicinske tehnologije Biomedical Technology	2	3 ali 4

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Lab. work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
15	20		10		105	5

Nosilec predmeta / Lecturer:

Prof. dr. Miha Drofenik
Doc. dr. Darko Makovec

Jeziki /	Predavanja / Lecture:	Slovenščina/Slovene
Languages:	Vaje / Tutorial:	Slovenščina/Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Kandidat mora doseči 300 ECTS na predhodnem študiju.

Graduate degree 300 ECTS

Vsebina:

Contents (Syllabus outline):

Nanostrukturiranimi materiali, ki vsebujejo nanodelce. Pomen nanodimenzije v bio okolju in prednosti nanomaterialov pred klasičnimi materiali v biomedicini. Podrobno bodo razloženi magnetni nanomateriali in njihove superparamagnetne lastnosti, ki dajo magnetnim nanodelcem veliko prednost pred ostalimi nanomateriali, ki se lahko uporabljajo v biomedicini.

Nanostructural materials that are based on nanoparticles. Purpose of nanodimensions in the bio environment and with their advantage with respect to classical materials. The properties of magnetic nanoparticles will be discussed in detail, and in particular superparamagnetic properties will be discussed. These materials offer a great advantage in comparison to other nanomaterials that can be applied in the biomedicine.

Najpomembnejši nanomateriali, ki se uporabljajo za različne postopke pri diagnostiki in zdravljenju. Poseben poudarek bo na materialih, ki temeljijo na magnetnih nanodelcih, ki se uporabljajo za selektiven vnos zdravil, magnetno hipertermijo, povečanje kontrasta pri magnetni resonanci (NMR), detekcijo in separacijo bioaktivnih molekul, itd. Magnetni nanodelci lahko zaradi svoje majhnosti potujejo po tkivu, hkrati pa so zaradi interakcije z magnetnim poljem sledljivi in vodljivi znotraj telesa pod vplivom zunanega magnetnega polja. Ker imajo absorpcijske sposobnosti, lahko služijo kot prenašalci ciljnih snovi na ciljna mesta v telesu. Na ta način lahko dosežemo relativno visoke koncentracije učinkovin na določenih patoloških mestih. Zaradi interakcije z elektromagnetnim valovanjem pri zmernih frekvencah in poljskih jakostih, magnetni nanodelci lokalno segrevajo okolico na programiranih mestih v telesu. Magnetni nanodelci vplivajo na okolico vodikovih protonov in izboljšajo kontrast pri NMR preiskavah. Nanodelci so pomembni tudi pri diagnostiki zunaj telesa (in vitro). Z modifikacijo površine magnetnih delcev se doseže selektivnost adsorpcije različnih bioaktivnih molekul, ki omogoča njihovo separacijo ter detekcijo. Za detekcijo antiteles, hormonov in podobnih substanc se lahko

Most important nanomaterials that can be used for applications in medical diagnostics and therapy. The emphasis will be on materials that are based on magnetic nanoparticles and which can be used in targeted drug delivery, magnetic hyperthermia treatment for malignant cells, for magnetic resonance contrast imaging (MRI) enhancements and the detection and separation of bioactive substances.

As a result of their nanodimension the magnetic particles can move across the tissue. On the other hand, the magnetic nanoparticles interact with an external magnetic field and can be traceable and dirigible inside the body when influenced by an external magnetic field. Since the particles exhibit absorption properties they can serve as drug deliverers to the targeting location in the body. Due to this, very high drug concentrations can be achieved on targeting pathological places. Due to the interaction of the magnetic nanoparticles with the magnetic field at moderate frequencies the magnetic particles can heat the environment at specific places in the human body. Magnetic nanoparticles influence the environment of hydrogen atoms and thus improve the contrast

izrablja spremembe v magnetni relaksaciji delcev ob selektivni absorpciji analiziranih substanc (magnetorelaksometrija).

during MNR investigations. The nanoparticles are important also during in-vitro diagnosis. With the modification of the nanoparticles' surfaces, selective absorption for various bioactive molecules is achieved, which makes possible their separation and detection. For the detection of antibodies, hormones and similar substances the magnetic relaxation of magnetic nanoparticles can be used (magnetorelaxometry).

Temeljni študijski viri / Textbooks:

1. B. M. Berkovski, V. F. Medvedov, M. S. Krovov, »Magnetuic Fluids: Engineering application«, Oxford University Press, Oxford (1993)
2. S. W. Charles, J. Poplewell, »Properties and application of magnetic liquids Handbook of Magnetic Materials«, vol 2 Ed K. H. J. Buschow, p. 153 (1986)
3. A. E. Merbach, E. Tóth, »The Chemistry of Contrast Agents in Medical Magnetic Resonance Imaging«, Wiley, UK, Chichester (2001)
4. Urs Hafeli (Editor), Wolfgang Schutt (Editor), Joachim Teller (Editor), Maciej Zborowski (Editor), »Scientific and Clinical Applications of Magnetic Carriers«, Plenum Pub. Corp., (2001)

Cilji:

Uporaba nanostrukturiranih materialov v biomedicini. Poudarek je na materialih, katerih lastnosti temeljijo na specifičnih lastnostih nanodelcev, ki jih vsebujejo. Materiali, ki vsebujejo nanodelce so pomemben del nanotehnologije, ki je trenutno v svetu najpomembnejša raziskovalna tematika in zajema študij, kontrolo in ravnanje z materiali z dimenzijo delcev pod 100 nm. Veliko zanimanje za področje nanotehnologije in nanoznanosti je povezano z možnostjo njene uporabe na različnih področjih, med drugim tudi v biomedicini. Zlasti magnetni nanodelci imajo izjemne možnosti za uporabo v biomedicini. Nanotehnologija omogoča raziskovalcem, da prilagodijo lastnosti materiala za delovanje na celičnem in molekularnem nivoju in prispevajo k napredku na področju biomedicinskih znanosti. Specifične lastnosti nanodelcev za uporabo v biomedicini.

Objectives:

Objectives: How nanomaterials can be used in biomedicine. The emphasis will be on materials with properties that depend on their nanostructure. Materials that are composed of nanoparticles are of importance in nanotechnology, which is currently one of the most significant research areas, and includes the study, control and application of materials consisting of nanoparticles with dimensions below 100 nm. The great interest in nanotechnology is associated with its potential for use in various techniques, and in particular in biomedicine, where magnetic nanoparticles are of key importance. Nanotechnology makes it possible to use materials on the cellular level, which can contribute to progress in the field of life sciences. Specific properties of nanoparticles used in biomedicine

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

Znanje o uporabnosti magnetnih nanodelcev oz. magnetnih tekočin v medicini

Prenesljive/ključne spretnosti in drugi atributi:

Nanotehnologija omogoča prispevek k napredku na področju biomedicinskih znanosti.

Metode poučevanja in učenja:

Knowledge and Understanding:

Knowledge of the applicability of magnetic nanoparticles and / or ferrofluids in medicine

Transferable/Key Skills and other attributes:

Nanotechnology enables contribution to progress on field biomedical sciences.

Learning and teaching methods:

Seminarsko ali projektno vodenje učenja

Seminar or project assisted teaching

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)
Ocenjevanje seminarske naloge z ustnim izpitom

Type (examination, oral, coursework, project):
Assessment of the coursework

Materialni pogoji za izvedbo predmeta :

Material conditions for subject realization

Obveznosti študentov:

(pisni, ustni izpit, naloge, projekti)

Izdelana in pozitivno ocenjena seminarska naloga ali projekt

Students' commitments:

(written, oral examination, coursework, projects):

Accomplished and approved / marked seminar work or project