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ABSTRACT BOOK

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BIOPOLYMAT KEYNOTE PRESENTATION

Nanoscale Systems Based on Amphiphilic Copolymers and its Interaction with Components of Living Objects.

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Abstract

Methods for the synthesis of water-soluble amphiphilic copolymers based on vinylpyrrolidone with terminal thioalkyl groups have been developed. In experiments on cell cultures and model animals, the safety of the use of the obtained copolymers in living organisms was shown. The synthesized amphiphilic copolymers are capable of spontaneous aggregation in aqueous media with the formation of nanoscale structures, which makes it possible to use them as liposome modifiers, as well as carriers of poorly and insoluble drugs. It was shown that copolymers of N-vinylpyrrolidone were suitable for the immobilization of proteins and peptides, as well as drugs used in the treatment of serious diseases such as tuberculosis and cancer. Using fluorescent labels, it was shown that large aggregates enter living cell cultures due to endocytosis, localizing in endosomes. At the same time, small aggregates penetrate living cells bypassing the endocytosis mechanism and are evenly distributed throughout the cytoplasm even into the cell nucleus. Methods for the introduction of functional groups of various natures into amphiphilic copolymers have been developed. It makes possible to additionally modify the polymers for targeted delivery to the affected organ and imaging on MRI. Also, the introduction of additional groups in the polymer allows the use of such nanosystems as carriers of nucleic acids for transfection in genetic engineering.

The work was supported by Ministry of Education and Science of the Russian Federation as part of the state assignment for the FSSM-2020-0004 project

Biography:

Mikhail I. Shtilman is a professor at the Mendeleev University of Chemical Technology of Russia. He completed his Ph.D. Diploma in 1964 and D.Sc. Degree in chemistry in 1985. His main research interests are in the synthetic design of polymeric biomaterials with specific properties – biocompatibility, compatibility with blood, biodegradability, bioactivity – for medicine, agriculture, biotechnology, genetic engineering. He is a research supervisor of 45 Ph.D. theses and 4 D.Sc. Author of more than 850 articles, patents, theses, and 7 monographs. He was awarded The Leibnitz Medal, The Leonard Euler Medal, “Orden of Ehre” by European Academy of Natural Sciences

New Approaches to the Regulation of Oxidative Polymerization for the Creation of Biomaterials

Yaroslav Mezhuev*, Anna Luss, Ivan Plyushchii, Igor Vorobev, Yuri Korshak and Mikhail Shtilman

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Abstract

It is known that the properties of polymers of aromatic amines and pyrroles are determined by the ratio of different types of units in the chain, surface morphology, molecular weight, and the nature of counterions. The microstructure of the chain, molecular weight and morphology of the resulting particles are determined by the temperature-concentration mode of the oxidative polymerization. Therefore, the establishment of the mechanism and kinetic regularities of oxidative polymerization is an important task of polymer materials science, including in relation to the problem of creating biomaterials. Polyaniline, polypyrrole and their derivatives exhibit high biocompatibility

after thorough cleaning. Areas of application in biomedical fields of nitrogen-containing polyconjugated systems include the manufacture of structural elements of biosensors, systems that simulate muscles, substrates for growing cells, carriers of biologically active substances sensitive to electrical and electrochemical effects, hemocompatible materials, materials with bacteriostatic activity. At the same time, the lack of clarity in the kinetic laws of oxidative polymerization and the debatable mechanism of this class of reactions limit the possibility of directed control of properties. In this work, theoretical approaches are formulated to predict the rate of oxidative polymerization of nitrogen-containing aromatic monomers, the structure of polymer chains and their molecular weights. Possible areas of application of the indicated polyconjugated systems in medico-biological fields are shown.

The work was supported by Mendeleev University of Chemical Technology of Russia. Project Number K-2020-001.

Biography:

Yaroslav Mezhuev was born in 1985 year, in 2008 year was graduated from D. Mendeleev University of Chemical Technology of Russia, where he continued his research activity. PhD from 2011 year, DSc from 2013-year, professor from 2016 year, Head of the Department of Biomaterials (2021), specialist in the field of kinetics and mechanisms of macromolecules synthesis reactions as well as obtaining polymer composite materials for medical and biological purposes.

Dialdehyde Polysaccharides as Polymer-Carriers in Medical Compositions for Bone Tissue Engineering

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Abstract

Reconstruction of bone defects in fractures remains a challenge. The risk of infection has led to widespread restrictions on the use of animal-derived bone substitutes and an increased interest in the development of fully synthetic polymer composites. The present work is devoted to the production of fully synthetic biodegradable composites for regenerative surgery. Open-pored samples based on dialdehyde polysaccharides were obtained in the following way: a collagen conjugate with dialdehyde polysaccharides was prepared, then it was mixed with water and various additives, and foamed from a frozen block. The composite tablet predominantly has pores with a diameter of 0.8-1 microns, which is most suitable for successful bone tissue regeneration. The rate of biodegradation in vitro was determined by the rate of release of L-hydroxyproline, since collagen contains a large amount of this amino acid. The use of dialdehyde dextran as a biodegradation inhibitor allows three times to reduce the rate of enzymatic hydrolysis. Highly oxidized dialdehyde carboxymethyl cellulose reduces the rate by 10 times. The interaction products of dialdehyde polysaccharides with collagen in *in vivo* experiments on Wistar mice degrade during subcutaneous implantation much slower than the initial collagen, which is probably due to a change in the substrate specificity of the product.

Thus, fully synthetic, biodegradable bone-substituting materials capable of releasing physiologically active substances at different times based on dialdehyde polysaccharides have been developed.

The work was supported by Ministry of Education and Science of the Russian Federation as part of the state assignment for the FSSM-2020-0004 project

Biography:

Luss Anna Leonidovna was born in 1991 year, in 2014 year was graduated from D. Mendeleev University of Chemical Technology of Russia. PhD from 2019-year, assistant professor from 2020 year, specialist in the field of composite biomaterials and nanoscale drug delivery systems.

Polysaccharide Carriers for Physiologically Active Naphthaldehyde - Gossypol

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Abstract

Dialdehyde polysaccharides are successfully used all over the world for the addition of amines, peptides and enzymes. However, the problem of reducing toxicity is especially acute not only for substances of a peptide nature, but also for containing reactive aldehyde groups. These include the cotton toxin gossypol - naphthaldehyde with a wide range of physiological activity. The main question remains whether dialdehyde polysaccharides are suitable for use as carriers of substances of naphthaldehyde nature

Two groups of gossypol-containing physiologically active polymers based on dialdehyde dextran and dialdehyde carboxymethylcellulose with different molecular weights, number of oxidized units and content of gossypol, have been synthesized and characterized. The main sites of covalent binding of gossypol with macromolecules of dialdehyde polysaccharides have been established. It was found that during the hydrolysis of polymer derivatives under conditions simulating physiological free gossypol is not released. The hydrolysis products contain naphthoquinones with eliminated aldehyde and isopropyl groups, as well as products of their further oxidation.

Thus, using the example of polymer derivatives of gossypol covalently bound to dialdehyde polysaccharides, it was shown that the Ringsdorf model is not universal and does not work in the case of using dialdehyde polysaccharides as carriers of aromatic aldehydes. The effect of a significant decrease in toxicity *in vitro* was found with the covalent binding of gossypol to carrier polymers. The synthesized polymers can be recommended for further research as promising antiviral drugs.

Biography:

Dyatlov Valerie Alexandrovich was born in 1956 year, graduated from Moscow Mendeleev Chemical Technological Institute (D.Mendeleev University of Chemical Technology of Russia) in 1978. PhD from 1991 year, DrSc from 2016 year. Professor from 2016 year. Expert in the area of polysaccharides, drug delivery systems, cyanoacrylates and polymer composite materials for medical application.

Nano-scaled Amphiphilic Poly(N-Vinylpyrrolidone)-based System for Delivery of DNA Plasmids Encoding Virus Glycoproteins

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Abstract

Rift Valley fever virus (RVFV) infections in humans are often manifested as mild self-limiting illness, although in some cases there are more severe symptoms, such as hemorrhagic fever and neurological complications. Recently, various RVFV vaccine strategies were proposed, including those, based on recombinant virus, protein subunit, virus-like particles or plasmid DNA. Among these strategies, DNA vaccines against RVFV have shown divergent results in animal models.

This study was focused on preparation of amphiphilic poly(N-vinylpyrrolidone) (Amph-PVP) nanoparticles (NPs) loaded with DNA plasmids encoding Gn and Gc glycoproteins of the Rift Valley fever virus and evaluation of humoral immune response in mice. In order to protect the DNA plasmids from cleavage by extracellular nucleases, they were loaded in self-assembled NPs from Amph-PVP derivatives modified with amino acids β-alanine or glycine.

Characterization of the obtained NPs in terms of their morphology, mean size and particle size distribution as well as Z-potential was carried out. The obtained NPs were administered in mice, and the enhancement of humoral response compared to immunization with native DNA plasmids was demonstrated. As the result, investigated approach of application DNA plasmids loaded Amph-PVP NPs could be promising for development of novel DNA-based particulate vaccines.

The work of Kuskov A.N. was supported by D. Mendeleev University of Chemical Technology of Russia (Project Number K-2020-018).

Biography:

Kuskov Andrey Nikolaevich was born in 1980, in 2003 year was graduated from D. Mendeleev University of Chemical Technology of Russia, PhD from 2007 year, DSc from 2017 year, now is the head of the Department of Technology of Chemical Pharmaceutical and Cosmetic Products and professor at the Mendeleyev University of Chemical Technology of Russia. Research interests – novel formulations, dosage forms and delivery systems on the basis of natural and synthetic polymers for biomedical, pharmaceutical and cosmetic products. Author of over 150 scientific publications and patents.

Radical Polymerization of Acrylamide in an Aqueous Solution with 1,3-Dimethylimidazolium Dimethyl Phosphate and Elemental Sulfur

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Abstract

Cross-linked polyacrylamide is one of the most popular and widely used polymers. Interest in it is caused by its structure, due to which it exhibits hydrophilicity, while remaining a non-ionic polymer. Polyacrylamide is a completely non-toxic substance (provided that it does not contain the AA monomer), so its gel is often used in medicine as a biomaterial and as a carrier for medicines. Also, one of the most well-known applications of polyacrylamide gels is protein electrophoresis.

Usually polyacrylamide gels are prepared by crosslinking polyacrylamide chains with N, N-methylene bisacrylamide. This paper describes a method for producing crosslinked polyacrylamide without additional introduction of a crosslinking agent into the reaction system.

The synthesis of the resulting gel proceeds without heat supply to the system, at atmospheric pressure and in only 2 stages (synthesis of the initiator and synthesis of the polymer itself).

1. The interaction of 1,3-dimethylimidazolium dimethylphosphate with elemental sulfur proceeds by the mechanism of nucleophilic attack by the oxygen atom of the dimethylphosphate anion of the ionic liquid with the formation of 1,3-dimethylimidazolium (phosphonooxy-)oligosulfanide.
2. In a concentrated aqueous solution of acrylamide, 1,3-dimethylimidazolium (phosphonooxy -) oligosulfanide was added (0.3 ml), stirred for 15 minutes, and then left to dry for 12 hours.

After washing with methanol of the resulting product, which is a solid white substance, the product was characterized using a set of analytical methods, including ^{1}H NMR, ^{13}C NMR, XRD, XRF.

The results obtained suggest that the polymerization of acrylamide proceeds according to a radical polymerization mechanism initiated by the radicals formed during the hydrolysis of 1,3-dimethylimidazolium (phosphonooxy-) oligosulfanide.

The work was supported by Dmitry Mendeleev University of Chemical Technology of Russia. Project number 2020-040.

Biography:

Natalia Pavlovna Tarasova was born in 1948, in 1972 graduated from Moscow Institute of Chemical Technology named after D. I. Mendeleev (now Dmitry Mendeleev University of Chemical Technology). In 1982 she graduated from Moscow Institute of Electronic Machinery Building (MS in computational mathematics). She holds PhD in Radiation Chemistry (1976), DSci in inorganic chemistry (1994), both from Mendeleev University where she continues her research in green chemistry for sustainable development. She is the corresponding member of the Russian Academy of Sciences (1997), division of chemistry and material sciences.

Transmembrane Drug Delivery Systems Based on Amphiphilic Poly-N-vinylpyrrolidone Nanocapsules

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Abstract

A huge number of attempts to obtain a biocompatible and biodegradable carrier of drugs with prolonged action based on polymers led to the fact that the most effective for this purpose is an amphiphilic polymer. The aim of this work was to obtain polymer nanoparticles based on amphiphilic poly-N-vinylpyrrolidone with incorporated model substance.

A number of amphiphilic polymers capable of forming aggregates in aqueous media have been obtained by radical polymerization of N-vinylpyrrolidone. During the synthesis, a number of mercaptans and amines containing from 8 to 18 carbon atoms were used as chain transfer agents. The structure of obtained polymers was confirmed by ^{13}C, ^{1}H NMR and IR spectroscopy, and the number average molecular weight was determined.

The micelles of amphiphilic poly-N-vinyl-2-pyrrolidone are capable of solubilizing the water-insoluble model drug curcumin. Two types of nanoprticles were prepared: small diameter nanoparticles (50 nm) and nanoparticles with an average diameter of about 200 nm.

The hydrophilic-hydrophobic balance of amphiphilic copolymers of polyvinylpyrrolidone was controlled in order to develop methods for producing nanoscale carriers with controlled hydrophobicity. The proposed approach makes it possible to control the hydrophobicity of the amphiphilic polymer. The use of a low molecular weight copolymer and a long-chain transfer agent makes it possible to obtain the most hydrophobic materials for the construction of micellar-type capsules.

The work was supported by Ministry of Education and Science of the Russian Federation as part of the state assignment for the FSSM-2020-0004 project.

Biography:

Anna Mikhailovna Nechaeva was born in July 1996 in Moscow. She was graduated from D.Mendeleev Univirsity of Chemical Technology of Russia, department biomaterials in 2020. Now she is PhD student of D. Mendeleev University of Chemical Technology of Russia.

Biocomposite Bone Substitute Materials Containing Polymer Drug Delivery Systems

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Abstract

A variety of biomaterials are widely used in modern regenerative medicine. Particularly in traumatology, products made from chemically stabilized bone matrices are used. Throughout the entire life of the implant, long-term protection against bacterial infection is required. Unlike living bone, a bioprosthesis is not able to resist bacterial attack on its own. The present work is devoted to the creation of new biocomposite materials based on bovine bone matrix covered with polysaccharide gel layers capable of locally releasing antibiotics when bacteria attack the prosthesis.

A biocomposite material based on a bone matrix was obtained as follows: pre-washed bovine bone was treated with hydroxyethyl starch modified with epichlorohydrin with a covalently bound broad-spectrum antibiotic - amikacin. Comparative tests of the bacteriostatic effect of the gel layer were carried out using the method of inhibition of the growth of the culture of *Staphylococcus aureus* P209 on agar medium. When the bioprosthesis comes into contact with the staphylococcus lawn a zone of growth inhibition is observed in a day around the sample, under the samples and on their surface. Thus, the release of amikacin occurs locally under the influence of a bacterial attack and stops with the destruction and removal of bacteria.

Thus, polymer systems for targeted delivery and controlled release of drugs have been developed, which allow the release of drugs from the prosthesis during a bacterial attack.

The work was supported by Ministry of Education and Science of the Russian Federation as part of the state assignment for the FSSM-2020-0004 project

Biography:

Kirill Sergeevich Kushnerev was born in 1995. In 2017 year were graduated from MIREA—Russian Technological University (Lomonosov Moscow State University of Fine Chemical Technologies) with bachelor's degree. In 2019 was graduated from D. Mendeleev University of Chemical Technology of Russia. Junior researcher in department of biomaterials D. Mendeleev University of Chemical Technology of Russia. Specialist in polysaccharides, bone substituting materials and implants.

Surfactant Precursors of Poly-2-Cyancrylate Nanoscaled Carriers for Intranuclear Transport of Physiologically Active Substances

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Abstract

Traditional methods of delivery of physiologically active substances have a number of disadvantages that reduce their effectiveness. The use of ethyl 2-cyanoacrylate and its derivatives as the main material for the preparation of nanoscaled carriers of various types is due to the fact that alkyl 2-cyanoacrylates can easily polymerize by the anionic mechanism even in the presence of traces of a weak nucleophile (for example, water) without any initiation. In addition, polyethyl-2-cyanoacrylates are biodegradable, biocompatible and non-toxic polymers which are approved for medical application as bone adhesives.

The aim of this work was to obtain new surface-active monomers based on ethyl cyanoacrylates and fatty long-chain alcohols, as well as to obtain nanosized particles based on these monomers.

As a result of the study, new adducts were obtained by the addition of fatty alcohols (hexanol, octanol, etc.) at a double bond to 2-cyanoacrylic ethers in presence of cyanoacrylic acid as inhibitor of polymerization. Their structure has been proven by ^{13}C NMR spectroscopy and MALDI TOF. Adducts are an intermediate stable monomer that allow the synthesis of nanosized carriers of drugs. The synthesis of 2-cyanoacrylate nanoparticles is carried out in aqueous media and avoids the use of organic solvents. Nanoparticles are easily resuspended after freez-drying and do not exchange contents with each other and the environment, because of partially cross-linked shell via polymerization. The resulting nanosized particles can be used for targeted therapy of various serious diseases, for example, tuberculosis and cancer.

The work was supported by Ministry of Education and Science of the Russian Federation as part of the state assignment for the FSSM-2020-0004 project

Biography:

Derevnin Igor Alexeevich was born 22 July 1998 year. Graduated from department of Chemical Technology of Plastics D.Mendeleev University of Russia. Now working under master's thesis in Department of Biomaterials D.Mendeleev University of Russia.

Application of a Biopolymer-based Sorbing System for Assessing the Condition of Exudating Wounds

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Abstract

Sorption-application systems based on biopolymers are successfully used in the treatment of both acute and chronic wounds. Marine polysaccharides (Sodium Alginate and kappa-Carrageenan) are able to form spatial gel structures in the presence of Na^+, K^+, and Ca^{2+} cations and retain a significant amount of liquid in their volume. Due to the ability to form gels *in situ* under physiological conditions, natural hydrocolloids were used as a sorbing complex in the composition of hydrophilic ointment. In our experiments, the sorption capacity of the developed hydrophilic system (ointment) was determined, which was 4.9±0.2 g of the model solution per 1 g of ointment for 24 hours.

The development of new drug forms with the possibility of non-invasive diagnostics of the condition of wounds is an actual task. Tracking changes in the pH of a wound can provide information about bacterial contamination and the healing stage. One of the simplest methods for determining pH is to use natural indicators. *Curcuma Longa Extract* (95 % Curcuminoids) was introduced into a hydrophilic ointment containing a 20 % mixture of anionic biopolymers and showed indicative properties as the polysaccharides swelled in the model solutions. The color transition of curcuminoids occurred at pH 7.4-9.2 due to keto-enol tautomerism, and it is in this range that the pH of chronic wounds changes.

Sorption-application systems based on biopolymers with the inclusion of natural chromophores can be used for rapid assessment and monitoring of the condition of exudating wounds.

Biography:

Trufanova E. A is a 1st year student of the master's degree program of Mendeleev University of Chemical Technology, Russia, The Department of Technology of Chemical Pharmaceutical and Cosmetic Products. Research interests: creation of interactive dressings, study of biomarkers of chronic wounds, plant antimicrobial substances. One of the authors of 4 scientific articles. Took part in 11th international conference «Biomaterials and nanobiomaterials: Recent advances safety-toxicology and ecology Issues» (Greece, 2020), Current aspects of chemical technology biologically active substances (Russia, 2020).

Development and Research of the Main Colloidal Properties of Cosmetic Emulsions for Skin Protection Against Environmental Pollution Stabilized by Mixture of Surfactants

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Abstract

Today air pollution become a global problem as it affects both for the environment and for human health. Different pollutants like particulate matter damage skin barrier by different mechanism. Development of skin care and cosmetic products last year's became one of the most important part for formulators to evaluate different kind of raw materials for creating textures that will not only protect skin but also have a good sensory profile [1-2].

In our scientific work we decided to create emulsion system stabilized by mixture of bio-based surfactants with best dermatological and active profile selecting different ratios of surfactants for best emulsification.The main goal pick up the best combination of components that will provide us unique skin sensory profile. Formulation with the best stability and skin performance contained combination of surfactants Plantapon LC-7 / Plantacare 2000 with ratio 1/1; 5/1; and Texapon SFA / Plantacare 2000 with ratio 1/5. It also contained Lanette O as main structurant in amount 4% by weight. It was found that the model emulsion system is a polydisperse system with a number-average droplet size diameter dn = 2.7 μm. Polydispersity of emulsions decrease, when containing of anionic surfactants in the composition increasing. Rheological behavior of emulsions depends on the ratio of anionic and non-ionic surfactants. The best viscosity and flow characteristics are observed with a surfactant ratio of 1/5. Future studies will be aimed at increasing the viscosity. Specific properties of emulsion systems can be identified.

Biography:

1. A. Mehling, H. Riedel, H. Gondek, R. Jung, J. Koch. Anti-Pollution: Safeguarding the Skin against Particulate Matter/ SOFW Journal 03/19 | Vol 145 | Thannhausen, Germany.
2. Niraj Mistry Guidelines for Formulating Anti-Pollution Products Cosmetics 2017, 4, 57.

Hydrogels Based on Modified Polyvinyl Alcohol as a Promising Material for Vascular Embolization

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Abstract

The work is devoted to the development of a technology for producing spherical calibrated particles based on unsaturated derivatives of polyvinyl alcohol. Previously, this material has shown it's effectiveness as a basis for a number of medical products, in particular, wound dressings and implants for replacing soft tissue defects. Polyvinyl alcohol is a synthetic polymer that is widely used in industry for commercial, medical and food applications. PVA is capable of gelation due to physical or covalent interactions. The latter can be obtained by chemical modification of the polymer, namely, by the covalent inclusion of glycidyl methacrylate into the side units, followed by crosslinking. The tissue-like, elastic properties and high-water content of PVA hydrogels make them beneficial for many biomedical applications, including contact lenses, controlled release matrices, bioadhesives, and intravascular embolic agents. Intravascular embolization is an effective treatment for various pathologies, including hypervascularized neoplasms. Various types of medical devices are used for intravascular embolization: coils for embolization, uncalibrated microparticles, calibrated microparticles, non-adhesive liquid embolizing systems and adhesive compositions. An ideal permanent embolic agent would have both mechanical and biochemical stability, mechanical stability would resist blood flow and reduce the potential for recanalization, and biochemical stability would control biodegradation. In addition, the agent must be non-toxic in order to avoid cardiovascular toxicity or a strong immune response. Finally, the agent must be safe for surgery to achieve good embolization results. Well-designed injectable polyvinyl alcohol based embolic agents can easily meet all the requirements of transarterial embolization. Calibrated spherical microparticles have high efficiency and relative ease of use and are used for embolization of uterine fibroids, prostate adenomas, arteriovenous malformations, hemangiomas, for preoperative embolization and for stopping bleeding. At the moment, there are various types of calibrated foreign made microparticles on the market. The main limitation for wider use of calibrated microparticles is their rather high cost - today the cost of a bottle containing 2 ml of particles is 20-25 thousand rubles. Taking all these factors into account, we believe that PVA-based hydrogel embolic material may be the most promising choice as an ideal embolic agent, demonstrating the advantages of both solid and liquid embolic materials.

Biography: Graduate student of the Department of Biomaterials at the Mendeleev university.

Method for Obtaining Polypyrrole Films by Manganese Dioxide Oxidative Polymerization on a Silica Gel Substrate and the Prospect of Using the Resulting Polymer as a Biosensor

I.V. Plyushchii*, Ya.O. Mezhuev, I.Yu. Vorobev, M.V. Motyakin and Yu.V. Korshak

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Abstract

The kinetics of pyrrole oxidative polymerization on a silica gel surface manganese dioxide activated was studied by EPR spectroscopy. The high activity of manganese dioxide as an oxidizing agent was shown. The reaction rate was limited by pyrrole diffusion from volume of a reaction system to the interface was found. The EPR method confirmed the absence of a pronounced autocatalysis effect observed in sedimentary polymerization. The obtained polypyrrole coatings are promising for use as biosensors for the determination of biologically active substances and metabolites.

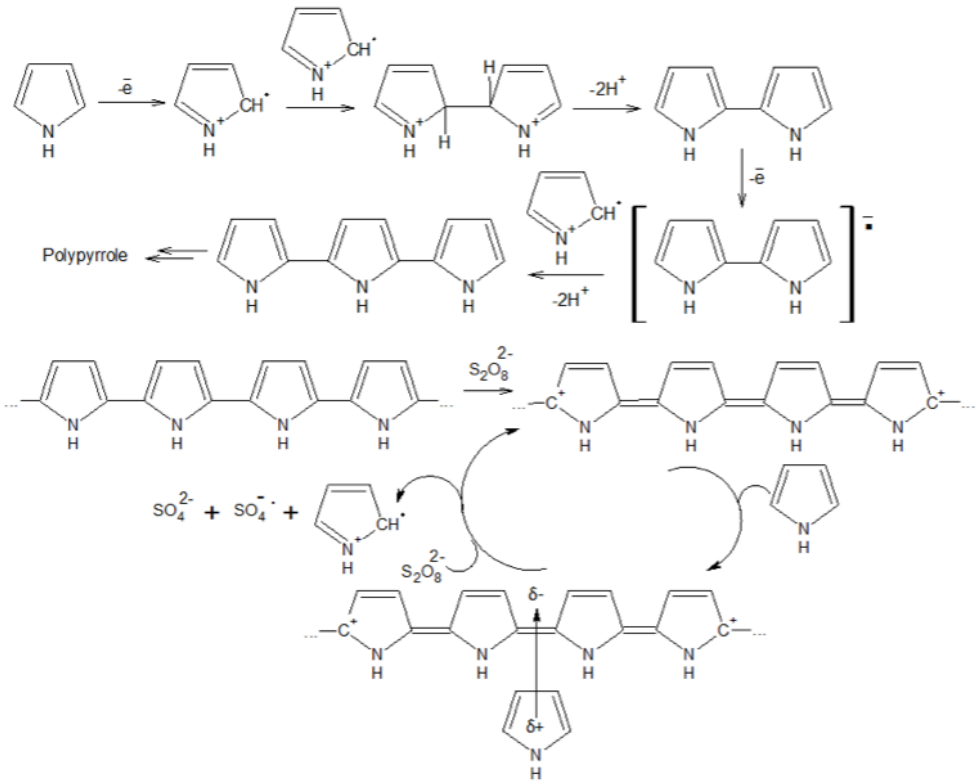
Key words: polypyrrole, oxidative polymerization, biosensors

The wide array of polypyrrole properties is creating a perspective opportunity to use it as materials with high biocompatibility. There are several main methods for polypyrrole synthesis which can be divided into two groups: chemical and electrochemical methods.

Electrochemical polymerization has a number of important shortcomings. The disadvantage of electrochemical polymerization is nessesary to use of conductive and semiconductor electrodes the disadvantage. Oxidative chemical polymerization doesn't has such disadvantages. In contrast, it allows to obtain polymer coatings, both on the surface of a substrate and in a reaction phase volume. Note however that the parallel polymerization in the volume phase creates defects on a polypyrrole coatings.

Method for obtaining pyrrole by oxidative polymerization is proposed in this paper, which allows avoiding reaction in volume and, as a result, a formation of defects on a coatings surface. In this technique uses silica gel surface previously modified with manganese dioxide for pyrrole oxidative polymerization. Polypyrrole film was formed on silica gel surface after exposure for an hour in a toluene solution with monomer, which had a significant effect on pore size distribution.

It was observed that interphase polymerization, a pronounced auto-acceleration effect is observed, rather than polymerization in volume. It should be noted that at the moment auto-acceleration effect during the sedimentary oxidative polymerization of pyrrole remains a subject for discussion. The authors suggest that auto-acceleration effect is caused by a charge transfer complex formation with the participation of a monomer and resulting polymer, as shown in Scheme 1.



Scheme 1. Mechanism of charge transfer complex formation

Absence of auto-acceleration is shown in kinetic regularities study of interphase oxidative polypyrrole polymerization by Electron-paramagnetic resonance (EPR). This may be due to the diffusion control of reaction, whereas sedimentary polymerization has a kinetic control reaction.

Polypyrrole obtained by interphase polymerization allows controlling substrate particles size, that increased it using as biosensors.

This work was financially supported by the Ministry of Science and Higher Education of the Russian Federation within the framework of a state task, project no. FSSM2020-0004.

Biography:

Ivan V. Plyushchii was born in Moscow, on 17 April 1993. In 2010 he went to D.Mendeleev University of Chemical Technology of Russia. He received his bachelor's degree in 2014 and master's degree in 2016. He then finished a post-graduate course in 2020. Now, Ivan V. Plyushchii is an investigator of Biomaterial department.

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