Annotation of articles
Sotir Ivanov Sotirov

№ 1

Insulating Chitosan/Casein Multilayers on Corona Charged Polylactic Acid Substrates

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IEEE Transactions on Dielectrics and Electrical Insulation (Volume: 25 , Issue: 3 , June 2018)

In the last decades, various methods have been developed to modify the surface properties of materials - such as Langmuir-Blodgett deposition and self-assembled mono- and multilayers. Among them, the layer-by-layer (LbL) selfassembly technique received renewed interest as an attractive technique for the production of thin polyelectrolyte multilayer films. Multilayer structures have been widely used, because of their fabrication easiness and great potential for application in drug delivery, biomedicine, optics, food science, and biomembranes. The physical principles of LbL are mainly based on electrostatic attraction between oppositely charged polyelectrolytes and charge overcompensation. In addition, some other forces, for example hydrophobic, van der Waals, and hydrogen bonding, should also be included under specific conditions. The multilayer built up by the LbL technique is characterized by precisely defined properties, flexible choice of assembled components, and the ability to cover surfaces of any size and geometry. The influence of the structure and physico-chemical properties of chitosan/casein multilayer films on their potential use for drug delivery systems was investigated. The multilayer films were prepared using layer-by-layer self-assembly, whereby chitosan and casein were deposited onto poly(lactic acid) substrates pretreated with either a positive or a negative corona. The corona discharge system consisted of a corona electrode, a grounded plate and a grid. The deposition was studied by ATR FT-IR, AFM, and surface energy measurements. ATR FT-IR spectra proved the formation of polyelectrolyte chitosan – casein complexes. The increasing content of chitosan and casein with increasing number of bilayers was further confirmed by XPS analysis. The surface topography was examined by AFM and the average roughness was evaluated. A comparative analysis of the experimental results was performed and the most appropriate substrate corona treatment for the irreversible binding of the chitosan/casein polyelectrolytes was determined. It was established that negative charged substrates are more suitable for formation of multilayers with a high roughness and better adhesive properties. These properties can ensure application of the investigated structures as drug delivery systems on mucous membranes.

№ 2

Innovative biopolymer nano-multylayered films for biomedical applications: fabrication and physical properties

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The build-up of new functional materials with controlled structures and properties in micro - and nano-dimensional scale is of essential interest because of their use in biomedicine, pharmaceuticals, tissue engineering, and regenerative medicine. From that point of view, the

layer-by-layer deposition of polyelectrolytes on a substrate is imposed and comparatively easy to realize. It is a technique, which includes a wide range of materials and surfaces, thanks to which it is possible to make nanostructured multilayer coatings. The polyelectrolyte structures formulated by layer-by-layer deposition represent an outstanding and successful solution to the high demands of pharmaceutical science, where innovative therapeutic systems that provide sustained release in a specific target area with unproved efficacy of well-known medical substances are targeted. The present chapter summarizes the investigations on the formulation and physicochemical properties of polyelectrolyte multilayer (PEM) deposited onto planar polymer substrates, with a potential application as drug delivery carriers on buccal mucosa. The progress and success in the designed PEM was monitored by the newest, modern methods for characterization of the PEMs such as FT-IR. UV-VTS spectroscopy, XPS, SEM. AFM, laser refractometry. Biocompatible polymers, like polypropylene, poly-s-caprolactone. and polylactic acid were used as substrates of PEM. Multilayers were formulated from different natural polyelectrolytes - chitosan, xanthan, pectin, poly-L-lysine, carboxymethylcellulose. The layer-by-layer deposition process was accomplished by two methods, spin-coating and dipping. The novelty in the PEMs presented here is the corona pretreatment of the substrate, which guaranteed an excess of charge |on the substrate surface and improved the conditions for polyelectrolyte anchoring. The experimental results suggested a successful, irreversible deposition of these well formulated PEMs. Changes in the deposition conditions led to corresponding changes in the PEMs structure, which gave one the route to precise modification of their properties in a desired direction, in accordance with the potential application. The effect of the surrounding environment - pH and ionic strength on the formulation and stability of the PEMs was also investigated.

№ 3

Effect of assembly pH and ionic strength of chitosan/casein multilayers on benzydamine hydrochloride release

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Multilayer biopolyelectrolyte films are built from chitosan and casein by layer-by-layer deposition onto corona precharged poly(DL-lactic acid) substrate. Such structure allows optimization with respect to the morphology and ability of drug immobilization and release by changing the assembly conditions. Variation of chitosan and casein solutions ionic strength and chitosan solution pH at constant casein solution pH, effects significantly the polyelectrolyte multilayer structure and drug release. pH and ionic strength increase change the morphology from dense to loose, and the ionic strength increase let to screening effect and complexation of the drug, resulting in slow drug release. The formulated LLPEMs from corona precharged PDLA substrate and polyelectrolyte layers of alternating casein and chitosan, where benzydamine hydrochloride (BH) drug was incorporated into chitosan layers showed significant dependence on the assembling conditions – pH and ionic strength. The analysis of the surface refractive index, swelling behavior, surface morphology, drug release showed that the increase of pH and ionic strength altered the structure from smooth and dense to rough and loose. The ionic strength increase led to screening effect of the counterions and

complexation, slowing down the drug diffusion process i.e. the drug release. The water contact angle was small and the free surface energy was at least 38 mJ/g, which together with the high polarity (above 0.68) guarantee good mucoadhesion.

№ 4

Investigation of Flexible Polyelectrolyte Multilayered Structure by Using Different Techniques

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*AIP Conference Proceedings **2075**, 160007 (2019); https://doi.org/10.1063/1.5091334*

Layer-by-layer (LbL) assembly of polyelectrolyte multilayers (PEMs) is a common way of surface modification and fabrication of novel nanostructures and could be realized by dipping, spraying, spinning and electromagnetic methods. LbL is considered to be the simplest, cost-effective process, as well as an innovative film production technique, but its application takes lot of time. It is known that PEMs are suitable for delivery of drug substances and find application in biosensors and tissue engineering. Various biomolecules (proteins, DNA, RNA or other desired molecules) could be incorporated into the PEM stack by electrostatic interactions. The presented paper deals with the formulation of medical pads with potential use as drug delivery systems via buccal mucosa adhesion. The pads consists of a substrate and deposited on it multilayered structure of alternating casein and chitosan. The method of preparation of this multilayer structure is layer-by-layer deposition. The electrolyte nature of the used polymers (chitosan – polyanion and casein – polycation) was employed in the formulation process. The substrate initial excess charge was provided by corona discharge pretreatment. Thus, on loaded PLA substrates, casein / chitosan PEMs have been successfully deposited. Multilayer growth was linear when the pad is positively charged and exponential at negative charged. The biggest amount of drug was loaded into 8 layers of PEMs when the multilayer structure was deposited onто a positively charged backing. As the number of layers increases, there is a tendency for slower drug release. Mucoadhesive properties were better in case of PEMs ending with a layer of chitosan. The formulation process was monitored by index of refraction measurements by using laser refractometer. The ability of the formulated pads as drug delivery system was proven by drug release tests, where the kinetics of benzydamine hydrochloride (BH) was used. The method of mucin reaction was employed to establish the potential of pads‘ adhesion.

№ 5

Novel ammonia sensor based on polyaniline/polylactic acid composite films

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Journal of Physics Conference Series 794(1):012023 · January 2017

We propose a new type of ammonia sensor based on composite film between polyaniline PANI, (emeraldine base) dissolved in dimethylformamide, and poly(DL-lactic) acid dissolved in chloroform. The two solutions were mixed in weight ratio of the components 1:1 and cast on Al2O3 substrate, on which silver electrodes were deposited previously. The active layer structure and morphology were examined by atomic force microscopy. The investigations made revealed the composite morphology and confirm the homogeneous distribution of PANI

particles with a average diameter of 500 nm in the PDLA matrix. The gaseous sensor measurements indicate that the PANI / PDLA nanocomposite sensors have a high rate of response / recovery, high sensitivity, good reproducibility and stability in a concentration range of 10 ppm to 1000 ppm. These characteristics are largely due to the large surface occupied by the PANI nanoparticles which are incorporated into the polymer PDLA matrix.
The sensor resistance at constant humidity and different ammonia concentrations was measured. It was found that an increase in the ammonia concentration leads to resistance increase. This result is explained in the terms of ionic interactions between the polyaniline and the ammonia, which change the permittivity of the sensor active media. The sensor is reversible and possesses response time of typically 100 s. Based on the changes of the sensor resistance, ammonia concentration from 10 ppm to 1000 ppm could be detected.

№ 6

Deposition of Polyelectrolyte Multilayer Films Made from Chitosan and Xanthan on Biodegradable Substrate: Effect of pH and Ionic Strength

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AIP Conference Proceedings, 2016, 1722, 220025

The aim of the present work is to investigate the effect of pH and ionic strength on the deposition of chitosan/xantan multilayers on preliminary corona charged substrates from polylactic acid. The multilayer films were formed by alternative dipping the substrate into chitosan and xantan polyelectrolyte solutions. For this purpose 0,1% chitosan solution and 0,05% xantan solution in acetate buffers with pH 4: 4,5 and 5 and ionic strengths 0:0.01:0.1 and 1 mol/l were used. Measurements have been made to show that the largest amounts of chitosan are deposited at pH 4.5 and below at pH 4 and pH 5, which suggests that the most suitable deposition conditions are at pH 4, 5. The morphology of the resulting layers was examined by an atomic-force microscope. From the measurements made, it can be excluded that the low-ionic structures obtained with a lower ionic strength are smooth and uniform, whereas those obtained at high salt concentrations show an increase in surface roughness.
The film properties were investigated by FTIR, laser refractometry, XPS and AFM methods. It was found that the binding of the polyelectrolytes to the substrate was irreversible over the time of deposition. The investigated parameters were found to depend on both pH and ionic strength of the polyelectrolyte solution. This behavior was attributed to the changes density of the polyelectrolytes and the screening effect of the counterions.

№ 7

Various Corona Treated Biopolymer Substrates for the Deposition of Polyelectrolyte Multilayers

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AIP Conference Proceedings, 2016, 1722, 220026.

In the present paper the effect of the substrate type and the corona polarity were investigated. Various biopolymer substrates (poly lactic acid (PLA), PLA with chitosan and lyophilized

PLA were prepared. These substrates were charged in a positive or in a negative corona and time dependences of the normalized surface potential were studied. After that multilayer films were formed by alternative dipping the substrates into chitosan and xanthan polyelectrolyte solutions. For this purpose 0.1% chitosan solution and 0.05% xanthan solution in acetate buffers with pH 4.5 and ionic strength 0.1 mol/l were used. The films' morphology was investigated by FTIR and SEM methods. A comparative analysis of the experimental results was presented and the most appropriate substrate type for the irreversible binding of the chitosan/xanthan polyelectrolytes was determined. The chemical composition of the films was investigated by FTIR-ATR spectra were collected by a Thermo Scientific™ Nicolet™ iS™10 FT-IR spectrometer,equipped with a diamond ATR accessory**,** in the range from 650 cm^{-1} to 4000 cm^{-1}. The morphology of the produced films was examined by scanning electron microscope Lyra 3 XMU (Tescan). The working voltage was 30 kV. Prior to the measurements, the samples were covered with a thin film of gold (about 30 nm). A comparative analysis of the experimental results was presented and the most appropriate substrate type for the irreversible binding of the chitosan/ xanthan polyelectrolytes was determined.

№ 8

Investigation of multilayered polyelectrolyte thin films by means of refractive index measurements, FT-IR spectroscopy and SEM

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Journal of Physics: Conference Series, 2016, 682, art. № 012026

Multilayered polyelectrolyte films are promising structures in the biomedical field. In order to meet the demands for biomedical applications, the structures have to be built from biocompatible and/or biodegradable, nontoxic starting materials, possessing some specific functional properties, depending on the particular application. In the present study, the multilayered polyelectrolyte films with potential use as buccal bioadhesive drug delivery systems were investigated. They were prepared via layer-by-layer deposition of successive nanolayers onto substrate. Three different biopolymers were used. The substrate, from poly(lactic acid), was solvent casted. After that, it was subjected to corona treatment, which ensures surface charge excess for the multilayer deposition. The nanolayers were prepared either from 0.01 g/L solutions of chitosan or 0.05 g/L xanthan. Acetate buffer (pH 4.5 and ionic strength 0.1 M) was used as a solvent. The substrate was dipped successively into one of the solutions, allowing formation of polyelectrolyte complexes of chitosan (polycation) and xanthan (polyanion). The multilayered structures consisted of 8, 9, 14, 15 or 20 nanolayers. Number of techniques, such as refractive index measurements, FT-IR spectroscopy and SEM morphology were employed in order to monitor the properties of the so prepared multilayered polyelectrolyte films.

№ 9

Electret stability of gamma irradiated PP and PET films

A. Viraneva, T. Yovcheva, K. Krezhov, S. Sotirov

Bulgarian chemical communications, 2015, 47(B), pp. 121-126.

The influence of the gamma irradiation on electrets stability of the polymer films of polypropylene and poly(ethylene terephtalate) was studied by following the surface potential decay with time and with sample's storage temperature. The electret surface potential was measured by the method of the vibrating electrode with compensation. Polymer film samples were subjected to integral irradiation doses (hEgi = 1:25 MeV, 60Co source) of 5 kGy and 25 kGy accumulated in air at a dose rate of 0.26 Mrad/h. After irradiation, the samples were charged in a corona discharge by means of a corona triode sistem for 1 minute under room conditions. Positive or negative 5 kV voltage was applied to the corona electrode and 1 kV voltage of the same polarity as that of the corona electrode was applied to the grid. Significant changes in the electret behaviour of the polimer films after gamma irradiation were established. The surface potential dacay depended on factors such as the corona polarity, the type of material and the irradiation dose. At 25 kGy the gammairradiation-induced enhancement of the electrets efficiency of the PP films achieved the highest value. The possible mechanisms of surface potential decay responsible for the observed irradiation dependent behaviour are discussed.

№ 10

Nanostructured polyelectrolyte multilayer drug delivery systems for buccal administration

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Bulgarian Chemical Communication,2016,48 (C), 68-474

Polyelectrolyte multilayers (PEMs) are well-defined nanoarchitectures with many potential applications, usually as biomaterial coatings. They possess excellent characteristics, such as fine tuning of thickness, stiffness, stability, morphology and topography. Hence they may exhibit special biological properties, such as mucoadhesion and local drug delivery. We present our recent investigations on layer-by-layer assembled polyelectrolyte multilayers from chitosan and xanthan on preliminary corona charged substrates from poly-ε-caprolacton. Polyelectrolyte multilayers were deposited by two different techniques – dip-coating and spincoating. The presence of PEMs on the substrates was proved by ATR FT-IR spectroscopy. The surface chemical composition was established by X-ray photoelectron spectroscopy (XPS). Further investigations on the morphology and topography of the samples were done by scanning electron microscopy (SEM) and atomic force microscopy (AFM). All the experimental data confirmed differences in the structure and surface properties of the PEMs assembled by dip-coating and spin-coating. An interfusion of the polyelectrolyte layers was observed in dip-coated PEMs, while flat and clearly separated layers were deposited by spin-coating. The ability to control the inner structure of the PEMs enables to manipulate the physical properties or chemical activity of the functionalized thin films. In this way tunable mucoadhesion and drug release properties could be achieved.

№ 11

Measurement of piezoelectric d33 coefficients in thin films-part 1: experimental setup description

Yovcheva T., Sotirov S., Viraneva A., Bodurov I., Kabasanov S.

Физика ДиЭлектриков (ДиЭлектрики-2017), 213-215

A device for precise measurement of the piezoelectric coefficient d33 in thin layers with a thickness of several μm is presented. To carry out the measurement, the piezoelectric sample is placed between two electrodes which are then pressed together by electromagnet. The main structural elements and mechanical features of the measuring device are described. An electronic circuit for amplifying and measuring the resulting piezoelectric signal is provided.
The developed setup is easy to use. It requires minimal operator training. An important advantage of the developed setup is the structure of the electrodes, wherein the lower measuring electrode is not rigidly fixed to the base. It is placed on a guiding bearing ball, which allows it to change its angle relative to the upper electrode. The goal is the electrodes to stand parallel to each other when a force is applied. The bearing ball ensures the large contact area between the sample and the electrodes. This solution leads to improved system parameters, and reduces the impact of the gaps on the accuracy. The precise adjustment of the mechanical stress on the sample by the current supplied to the electromagnet makes it possible to achieve high repeatability measurements.

№ 12

Measurement of piezoelectric d33 coefficients in thin films-part 2: experimental results

Yovcheva T., Sotirov S., Viraneva A., Bodurov I., Kabasanov S.

Физика Диэлектриков (Диэлектрики-2017), 216-218

The aim of this work is to demonstrate the possibilities of the proposed device. Two measurement series of the *d*33 piezoelectric module are carried out. The first series of experiments explores the circular samples of piezoceramics lead zirconate titanate (PZT) with thickness 600 μm. The second series of experiments investigate thin polymer films from polytetrafluoroethylene (PTFE) with a thickness 80 μm and the polyethylene terephthalate (PET) with a thickness 100 μm, having the shape and the diameter of the two measuring electrodes. Before the measurement, the samples are charged in the corona discharge. The corona charging of the samples was carried out by the method of the corona discharge using a point-to-plane three-electrode corona discharge system. The experimental results on PZT films, charged PET and charged PTFE films with known piezoelectric coefficients indicate that the proposed device is accurate within the experimental uncertainty.

№ 13

Software for measuring the characteristics of photovoltaic panels

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Bulgarian Chemical Communications, Volume 48, Special Issue E (pp. 152 - 157)
2016

This paper presents the design and the development of specialized software, by which the characteristics of a photovoltaic panel can be tested and analyzed. The software controls a hardware module, which implements the electrical load of a photovoltaic

panel and monitors its voltage. The values, measured by the hardware module, are transmitted to a PC via a serial interface. Then, these values can be visualized in a graphic form by the software, which allows the plotting of the volt-ampere and the power-volt output characteristics of the photovoltaic panel. The elaborated software enables us to set the parameters of the study: initial current and the current increment steps. The measured parameter values are recorded as PC files, allowing subsequent visualization and examination of data. The developed software proposes a fast and easy solution for making a device for studying the parameters and characteristics of photovoltaic cells and modules. Modern easily accessible components and circuits are used for the hardware part, controlled by the developed software. The software can be successfully used for studying both individual cells and entire modules from photovoltaic systems.

№ 14

A device for the analysis of photovoltaic panels

S. I. Sotirov, D. K. Gospodinov , D. A. Zlatanski

Bulgarian Chemical Communications, Volume 48, Special Issue E (pp. 147 - 151), 2016

In this paper we present the elaboration and functioning of an electronic unit for examining the Volt-Ampere (V-I) and the output (P-V) characteristics of a PV panel. The unit was designed by us to record the PV panel voltage at different current loads. A digitally controlled electronic load was developed to set the current values by a chosen increment. Then, the unit measures the corresponding voltage value for each current value by an analog-digital converter (ADC). All pairs of values are used as input to a microcontroller and then transferred to a PC, where they can be graphically visualized by a specialized software. Different PV panels with varying output (P-V) characteristics were used to test the performance of the elaborated electronic unit. These experiments revealed that the unit is appropriate for PV panel analysis both under laboratory and field conditions.

№ 15

Design and development of an electrostatic voltmeter based on surface potential sensor

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IEEE Xplore Digital Library, DOI: 10.1109/ET.2018.8549626

This paper deals with the design and development of an electrostatic voltmeter based on surface potential sensor. For the realization of the device, constructed by us, a surface potential measuring sensor EFS-22D has been used, consisting of a measuring probe and an electronic converter for measuring voltages in the range from 0V to 900V at a distance between the sample and the surface of the probe within 1 – 3.5mm. The measuring probe is composed of an oscillating mechanism (of the type of a tonometer), with metal electrodes attached to it, which block the electric field. The movement of these electrodes is

accomplished by means of a piezo-electric element. The chopper is tuning fork oscillator type shutter. The surface potential, measured by the probe of the sensor, is converted into analogue voltage, varying from 0 to 4.5V, which is then converted into a digital value by a 15-bit sigma-delta analogueto-digital converter, connected to a microcontroller. The data from the measurements are transmitted from the microcontroller to a personal computer through a Bluetooth module. User software has been developed, allowing for: recording the obtained values from the measurements; their visualization both in digital and analogue form; digital filtration of the noise from the sensor; and statistical analysis of the obtained data

№ 16

Technology enchanced education by QR codes

S. Stoyanova-Petrova, N. Kafadarova, D. Stoyanova, N. Mileva, S. Sotirov, N. Vakrilov

EDULEARN18 Proceedings, pp. 6207-6210, 2018

The advantages of mobile technology lead to its rapid implementation in education. QR codes and the mobile devices are becoming increasingly used as teaching tools in the conventional education. They support the learning process by introducing more attractive, motivating and technologically enhanced learning materials. This paper describes our approach to implementation of QR codes in teaching electronics in higher education. In this study, QR Codes were added as support materials to laboratory exercises of the Electronics course in the University of Plovdiv. We created multimedia materials in the form of video of the teacher explaining the methodology of the exercise. By the use of QR codes students have access to practical guides and other information related to the practices of the subject. For each laboratory exercise a QR code has been developed and is placed next to the appropriate Breadboard in the Electronics laboratory. This helps students in performing laboratory practices by presenting them the procedures of the practical session. This methodology allows adapting the teaching process to the learning speed of the study material of each student. That means greater flexibility and convenience to suit students' active learning process.

№17

Lorawan based sysytem for measurement and monitoring of temperature and humidity in data centers and server rooms

Димитър Токмаков, Сотир Сотиров, Слави Глухов

Scientific Works of the Union of Scientists in Bulgaria – Plovdiv Series C. Technics and Technologies,Vol. XVII, pp165-168, 2019

This paper describes the realization of a wireless temperature and relative humidity measurement node used in datacenters and server rooms that transmit data to a LoraWan gateway via a LoraWan communication link. The temperature and relative humidity measuring node is built up by the microcontroller ATMEGA328, the Lora radio transceiver module RFM95W and the capacitive digital sensor DHT22 (AM2302). DHT22 measures a temperature of -40 ° to 80 ° C and relative air humidity in the range 0% - 99%. It has a pre-calibrated digital output and features great reliability and stability. The accuracy of humidity measurement is +/- 2% and at +/- 0.5%. The interface of the sensor is 1-Wire, the refresh rate is 1Hz. The power supply to the sensor node uses 3.7V Li-Ion battery type 18650 and linear low drop regulator for 3.3V with low quiescent current. The article presents values of the

measurements made with the system. The user interface of a client application using the myDevices platform and the Cayenne LPP communication protocol. You can see the measured temperature, relative humidity, signal / noise ratio, signal strength indicator (RSSI), and last measurement time. An interactive map can determine the physical position of the sensor node. The measurement system presented in this paper measures real-time temperature and relative humidity in data centers and server rooms. Using LoraWan wireless communication link the data is forwarded by the LoraWan gateway and sent to the Internet cloud application for processing, archiving and visualization. The LoraWan gateway and sensor node described in the present work are installed in the University of Plovdiv ''Paisii Hilendarski'', Bulgaria. The implementation of LoraWan based measurement system has a number of advantages over traditional data center measurement and monitoring systems: possibility of mounting the measuring node at random location without connecting wires, battery power supply with low power consumption, collection and processing of measurement data for their use to optimize the operation of the air conditioning and ventilation system.

№18

A non-contact voltage measurement system using surface potential sensor

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Scientific Works of the Union of Scientists in Bulgaria – Plovdiv Series C. Technics and Technologies, Vol. XVII, pp.169-172, 2019

This work presents the results of a new design of a complete non-contact voltage acquisition system, based on surface potential sensor EFS-22D by TDK. The system is capable to measure DC voltages from 0-950V with distance between the surface potential sensor and the probe within 1 – 3.5mm. The signal from EFS-22D sensor which is in the range from 0-4.5V dc is converted from the built in analog to digital converter in ATMEGA328 microcontroller. The results from the measurements are send to LabVIEW application using Bluetooth module. The LabVIEW application provides interface for further data acquisition and visualization. Achieved accuracy in the range of 0-950 V is 500 mv, which allows the measuring system to be used for various applications as well in university education in physics and electronics. The voltmeter proposed in this paper can be used for studying various types of dielectric materials, as well as for investigating voltage sources with ultra-high internal resistance. The use of LabVIEW virtual instrument software allows the system to be used in industrial production environments for express ESD measurement and control.

№19

Investigation of superfast deposition of metal oxide and Diamond-Like Carbon thin films by nanosecond Ytterbium (Yb+) fiber laser

V. Serbezov, S. Sotirov, K. Benkhouja, A. Zawadzka, B. Sahraoui

Optical Materials, 2013, 36, p. 53-59

Metal oxide (MOx, M: titanium, magnesium) and Diamond-Like Carbon (DLC) thin films were synthesized by Pulsed Laser Deposition (PLD) at room temperature and low vacuum of 2 Pa for MOx and vacuum of 4 x 10^{-3} Pa for DLC films. A fiber based Ytterbium (Yb+) laser operating in the nanosecond regime at a repetition rate of 20 kHz was used as an ablation source. Dense and smooth thin films with a thickness from 120 to 360 nm and an area of up to 10 cm^2 were deposited on glass and stainless steel substrates at high growth rates up to 2 nm/s

for a laser intensity of 10–12 J/cm^2. The thin films synthesis was compared for two fiber laser modes of operation, at a repetition rate of 20 kHz and with an additional modulation at 1 kHz. The morphology, chemical composition and structure of the obtained thin films were evaluated using optical microscopy, Scanning Electron Microscopy (SEM), Energy ispersive X-ray Spectroscopy (EDX) and Raman spectroscopy. The morphology of the MOx thin films and the deposition rate strongly depend on the fiber laser mode of operation. Very smooth surfaces were obtained for the metal oxide thin films deposited at lower deposition rates in the modulation mode at 1 kHz. The effect of the substrate on the DLC film structure was studied. The films deposited on dielectric substrates were identified as typical tetrahedral (ta-C) DLC with high sp3 content. DLC films on metal substrates were found typical a-C amorphous carbon films with mixing sp2/sp3 bonds.

№20

One-step synthesis of Hybrid inorganic-organic nanocomposite coatings by novel Laser Adaptive Ablation Deposition technique

Valery Serbezov, Sotir Sotirov

SPIE 8770, 17th International School on Quantum Electronics: Laser Physics and Applications, 87700G (2012)

A novel approach for one-step synthesis of hybrid inorganic-organic nanocomposite coatings by new modification of Pulsed Laser Deposition technology called Laser Adaptive Ablation Deposition (LAAD) is presented. Hybrid nanocomposite coatings including Mg- Rapamycin and Mg- Desoximetasone were produced by UV TEA N_2 laser under low vacuum (0.1 Pa) and room temperature onto substrates from SS 316L, KCl and NaCl. The laser fluence for Mg alloy was 1, 8 J/cm^2 and for Desoximetasone 0,176 J/cm^2 and for Rapamycin 0,118 J/cm^2 were respectively. The threedimensional two-segmented single target was used to adapt the interaction of focused laser beam with inorganic and organic material. Magnesium alloy nanoparticles with sizes from 50 nm to 250 nm were obtained in organic matrices. The morphology of nanocomposites films were studied by Bright field / Fluorescence optical microscope and Scanning Electron Microscope (SEM). Fourier Transform Infrared (FTIR) spectroscopy measurements were applied in order to study the functional properties of organic component before and after the LAAD process. Energy Dispersive X-ray Spectroscopy (EDX) was used for identification of Mg alloy presence in hybrid nanocomposites coatings. The precise control of process parameters and particularly of the laser fluence adjustment enables transfer on materials with different physical chemical properties and one-step synthesis of complex inorganic- organic nanocomposites coatings.

№21

Hybrid nanocomposite coatings from Metal (Mg alloy)-Drug deposited onto medical implants by Laser Adaptive Ablation Deposition technique

Valery Serbezov, Sotir Sotirov, Svetlin Serbezov

Proc. SPIE 8770, 17th International School on Quantum Electronics: Laser Physics and Applications (2012).

Drug-eluting medical implants are active implants whose function is to create healing effects. The current requirements for active medical coatings for Drug-eluting medical implants are to be biocompatible, biodegradable, polymer free, mechanically stable and enable a controlled release of one or more drugs and defined degradation. This brings hybrid nanocomposite coatings into focus especially in the field of cardiovascular implants. We studied the properties of Metal (Mg alloy)-Paclitaxel coatings obtained by novel Laser Adaptive Ablation Deposition Technique (LAAD) onto cardiovascular stents from 316 LVM stainless steel material. The morphology and topology of coatings were studied by Bright field / fluorescence optical microscope and Scanning Electron Microscope (SEM). Comparative measurements were made of the morphology and topology of hybrid, polymer free nanocomposite coatings deposited by LAAD and polymer drug coatings deposited by classical spray technique. The coatings obtained by LAAD are homogeneous without damages and cracks. Metal nanoparticles with sizes from 40 nm to 230 nm were obtained in drug matrixes. Energy Dispersive X-ray Spectroscopy (EDX) was used for identification of metal nanoparticles presence in hybrid nanocomposites coatings. The new technology opens up possibilities to obtain new hybrid nanocomposite coatings with applications in medicine, pharmacy and biochemistry.

№22

Preparation and characterization of the structure and thermal properties of biodegradable composite films of chitosan and polylactic acid.

T. Grancharova, S. Sotirov, M. Marudova

Пловдивски университет „Паисий Хилендарски“, научни трудове, том38, кн.4, 2013-физика (180-184)

The subject of this article is the study of structure and thermal properties of composite films from Chitosan and Polylactic acid composite films obtained by casting from a solution of the polymers in hexafluoro-2-propanol. The films are made from 1% chitosan solution and 2% polylactic acid solution in hexafluoro-2-propanol, which are mixed in different ratios and homogenized by magnetic stirrer for 10 min. The solutions are poured into teflon plates and dried at 34 ° C. The resulting films have a 1: 0, 9: 1, 7: 3, 1: 1, 3: 7, 1: 9, 0: 1 mass ratio of chitosan / polylactic acid, respectively. In the structural and thermal study of chitosan and polylactic acid composite films, the following more important conclusions can be made: chitosan and polylactic acid are incompatible and form a phase-separated system with a homogeneous matrix of chitosan and crystalline structures of polylactic acid; in the case of polylactic acid enhancement in films, the crystal structure changes from fine grain to coarse grain; the degree of CRP crystallinity is minimal at a mass ratio of 1: 1 polymers, where large steric hindrances to crystallization may occur.

№23

Deposition of polyelectrolyte multilayer films of chitosan and xanthan on a pad of poly-epsilon-caprolactone

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Нано-науки и нано- технологии, Паисий Хилендарски, 2017, (87-96)

In this chapter of the book "Nanosciences and Nanotechnologies", the use of polymers and nanofilms in pharmacy is considered. A scientific study has been presented for the preparation of polyelectrolyte multilayer films of two polymers - chitosan and xanthan, deposited by the electric self-assembled method on poly-epsilon-caprolactone substrates. The composition of nano materials was investigated by infrared and photoelectron spectroscopy, and the topography and morphology of the samples by scanning electron and atomic force microscopy. The research proves the successful application of the electrostatic self-assembled method in the deposition of polyelectrolyte layers of chitosan and xanthan on loaded biodegradable substrates. The binding of the polyelectrolytes to the substrates is irreversible, as the growth of the layers is mainly due to ionic interactions and the formation of polyelectrolyte complexes. Surface roughness and chemical composition indicate the presence of diffusion and mutual penetration of the polyelectrolytes. The ability to control the internal structure of PFM allows a directed change in their physical properties and chemical activity. It is thus possible to obtain structures with controlled adhesion and prolonged drug release.

№24

Wireless microprocessor system for temperature measurement

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The increasing interest in monitoring temperature variation in various industrial processes in the industry has led to the development of a large number of wireless systems for measuring and collecting the data received. The developed system consists of a special interface MAX6675, which performs measurement and digital conversion of thermocouple signals obtained from thermocouple type K, microcontroller PIC16F877, which connects between the interface diagram and the wireless bluetooth module BTM222. The digital temperature data obtained is transmitted in series to a personal computer via the bluetooth module where it is handled by a specially designed user program. The software allows a certain number of measurements to be displayed in graphical and digital form on the PC screen as well as to be recorded in a text file. It is possible to make specific settings of the measurement process, such as changing the time interval between the individual measurements, setting a certain number of measurements. A digital filter has been developed to increase the noise and reliability of the system.

№25

Mobile device for on-board diagnostics of vehicles

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Almost all cars produced today are equipped with an interface for connecting diagnostic test equipment. The transfer of data via these interfaces has been accomplished through several protocols, but none of them can be used directly by personal computers or smart devices. For this purpose, the ELM327 integrated circuit is designed to provide communication between vehicle diagnostic interfaces (OBD) and a standard serial interface found on personal computers. The data from all sensors as well as the diagnostic information stored in the vehicle's electronic control unit (ECU) can be read through the OBD. The development of the OBD II on-board diagnostics interface in recent years has led to the creation of a wide variety of reading devices through this diagnostic port. This article describes the implementation of a mobile device for on-board diagnostics of vehicles. The developed system consists of an interface circuit ELM327 providing communication between vehicle diagnostic interfaces (OBD) to a standard serial interface to which the Bluetooth module BTM222 is connected. The received digital data is transmitted in series to a mobile smartphone device via a Bluetooth module where it is visualized in a user-friendly manner through specially designed software.