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Posters

Fatemeh Mohammaddoost et al., J Biotechnol Biomater 2018, Volume 8
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In vitro bioactivity of a biocomposite HA/ZrO_2 fabricated from bovine bone by high energy ball milling technique

Fatemeh Mohammaddoost[1] and **Joanna Borowiec**[2]
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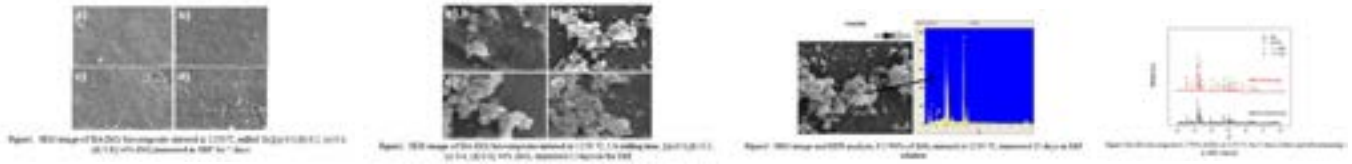
[2]Sichuan University, China

The superior biocompatibility and bioactivity of hydroxyapatite (HA) ceramic has attracted much attention as a substitute material in bone grafting. In the present work, the HA was produce from bovine bone while zirconia powder was supplied by the China (Mainland) trading company. In this work, HA/ZrO_2 biocomposite prepared with different wt % (0.0, 0.2, 0.4 and 0.8) of ZrO_2 concentrate, sintered at 1250 °C, 1 h milling time. In this project, the bioactivity test was carried out by soaking the sample in simulated body fluid SBF solution, 7 and 15 days in an incubator maintained at 36.5 °C. For instance, bioactivity was studied by soaking the samples in the SBF solution followed by the SEM, EDX analysis as well as XRD. The SEM results showed the apatite on the surface of HA/ZrO_2 biocomposite on a 7 days growth and when the immersion time increased to 15 days, the growth of apatite on the surface increased more. Other than that, the EDX showed that the covered layer on the surface was P and Ca as well as O. The XRD results showed that the soaked HA/ZrO_2 biocomposite composed HA, α-TCP, β-TCP and ZrO_2 and no other phases were detected.



Recent Publications

1. Barakat N A, Khil M S, Omran A, Sheikh F A and Kim H Y (2009) Extraction of pure natural hydroxyapatite from the bovine bones bio waste by three different methods. Journal of Materials Processing Technology 209(7):3408-15.
2. Chavan P N, Bahir M M, Mene R U,Mahabole M P and Khairnar R S (2010) Study of nanobiomaterial hydroxyapatite in simulated body fluid: Formation and growth of apatite. Materials Science and Engineering:B 168(1):224-230.
3. Radha G, Balakumar S, Venkatesan B and Vellaichamy E (2015) Evaluation of hemocompatibility and *in vitro* immersion on microwave-assisted hydroxyapatite-alumina nanobiocomposite. Materials Science and Engineering C: Materials for Biological Applications 50:143-150.
4. Ruksudjarit A, Pengpat K, Rujijanagul G and Tunkasiri T(2008) Synthesis and characterization of nanocrystalline hydroxyapatite from natural bovine bone. Current Applied Physics 8(3):270-272.
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Biography

Fatemeh Mohammaddoost has obtained her Master's degree in Material Science and Engineering from University Putra Malaysia. She has her expertise in biomaterial, synthesis from bio waste to use as a medical replacement. Her studies based on high energy ball milling technique to improve the physical properties which is a new method to synthesis hydroxyapatite from bio waste, to create new pathways for improving medical application by simulation body fluid test.

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Matjaž Godec et al., J Biotechnol Biomater 2018, Volume 8
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Biodegradability of an FeMn17 alloy

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Institute of Metals and Technology, Slovenia

Metallic materials play an essential role as biomaterials to assist with the repair or replacement of bone tissue that has become diseased or damaged. Plates, screws and pins used to secure serious fractures must be removed by a second surgical procedure after the tissue has healed sufficiently. Repeated surgery increases costs to the health care system and risk to the patient. To overcome these problems biodegradable materials can be used which temporarily support tissue healing and are completely degraded in certain time. Fe-Mn alloys are promising candidates for biodegradable metallic materials because of excellent mechanical properties, which are usually obtained by multi stage forming processes. However, biodegradability rate is usually not sufficient and last too long, degradation is not continuous and sometimes flakes are formed. The main goal of current research is to understand different production processes: casting, hot rolling and annealing; on the corrosion behavior of the biodegradable FeMn17 alloy due to the formation of less-corrosion-resistant deformational martensite. With additions of Mn the mechanical properties increase and the corrosion resistance decreases. The process parameters influenced the biodegradability as well as the mechanical properties. The produced material, cast and hot rolled, has interior stress and that increases the biodegradability, though the annealing process increases the stability of the material and the corrosion resistance.

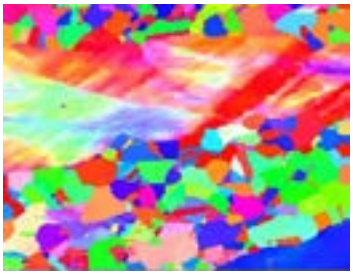

Figure 1: EBSD-IPF map of FeMn17 after hot rolling.

Recent Publications

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4. Hufenbach J, Wendrock H, Kochta F, Kühn U, Gebert A (2017) Novel biodegradable Fe-Mn-C-S alloy with superior mechanical and corrosion properties. Materials Letters. 186:330-333.
5. Kocijan A, Paulin I, Donik Č, Hočevar M, Zelič K, Godec M (2016) Influence of Different Production Processes on the Biodegradability of an FeMn17 Alloy. Materials and Technology. 50(5):805-811

Biography

Matjaž Godec has his expertise in characterization of metallic materials, especially using EBSD technique. His research interests are metallic materials characterization (SEM, TEM, AES, XPS), physical-chemistry of metallic surfaces, biodegradability of metallic materials, rapid solidification technology, tool steels carbides transformation, EBSD analysis of carbides, metallic materials surface nanostructuring, R&D of different steel grades and R&D of aluminum alloys. He is the Director of Institute of Metals and Technology, Ljubljana, Slovenia since 2011 and is a Group Leader of Physics and Chemistry of Surfaces of Metallic Materials.

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Tianqing Liu et al., J Biotechnol Biomater 2018, Volume 8
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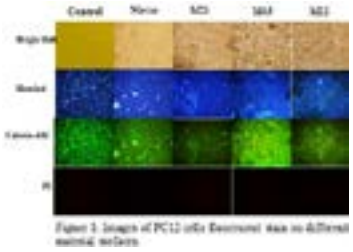
Preparation of PVDF-g-PNIPAAm thermo-sensitive fiber membranes by electrostatic spinning and application in cultivation and harvest of cells

Tianqing Liu, Kedong Song, Dan Ge and Shui Guan
Dalian University of Technology, China

Trypsin digestion has long been the main way to harvest anchorage-dependent cells. But trypsin will damage the proteins of extracellular matrix, leading to the degradation of the structure and function of cells. Cultivating cells on thermo-sensitive material, then harvesting cells by lowering temperature, can make the extracellular matrix maintain integrity. In this study, a series of PVDF-g-PNIPAAm thermo-sensitive fiber membranes, M21, M43, M11, and M45 were prepared by electrospinning. Fourier transform infrared spectroscopy and NMR-H spectrum were used to characterize that the PNIPAAm was grafted successfully. The morphology of each fiber membrane was observed by scanning electron microscope, indicating that the grafting percentage of PNIPAAm influenced the spinnability of PVDF. Fourier transform infrared spectroscopy of PVDF and PVDF-g-PNIPAAm fiber membranes showed that electrostatic spinning would not change the structure of thermo-sensitive polymer. PC12 cells were seeded on the surfaces of M21, M43 and M11 for cell experiments. The cell adhesion, proliferation and growth on different fiber membranes were examined. Then the harvested cells on different fiber membranes with temperature reduction were compared with those harvested by trypsin digestion method. The images of cell live/dead fluorescence staining showed that cells in different fiber membranes all had a high viability and the prepared thermo-sensitive fiber membranes had good biocompatibility. The MTT results showed that the nanometer fiber structure was conducive to the proliferation and growth of cells. The cells grown on the surface of M21 were the best and relatively poor on the M11, which indicated that higher grafting ratio is not suitable for the adhesion and growth of cells. Finally the cells cultivated on the three thermo-sensitive fiber membranes after three days were harvested with temperature reduction, showing that high grafting ratio is advantageous to the detachment of cells. Compared with trypsin digestion method, the temperature reduction method has significant advantages.



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1. Kato A, Kan K, Ajiro H, et al. (2017) Development of a rapid *in vitro* tissue deadhesion system using the thermoresponsive sol-gel transition of hydroxybutyl chitosan. Journal of biomaterials science polymer edition 1:16.
2. Nagase K, Sakurada Y, Onizuka S, et al. (2017) Thermoresponsive polymer-modified microfibers for cell separations. Acta biomaterialia 53:81-92.
3. Sudo Y, Sakai H, Nabae Y, et al. (2016) Role of hyperbranched polystyrene on thermo-responsive cell culture dishes prepared by hyper branched polystyrene-g-poly (N-isopropylacrylamide). Polymer 100:77-85.
4. Mellati A, Kiamahalleh M V, Madani S H, et al. (2016) Poly(N-isopropylacrylamide) hydrogel/chitosan scaffold hybrid for three-dimensional stem cell culture and cartilage tissue engineering. Journal of Biomedical Materials Research Part A 104(11):2764-2774.
5. Sudo Y, Sakai H, Nabae Y, et al. (2015) Preparation of hyperbranched polystyrene-g-poly(N-isopropylacrylamide) copolymers and its application to novel thermo-responsive cell culture dishes. Polymer 70:307-314.

Biography

Tianqing Liu, PhD in Chemical Engineering is the Director of R&D Center for Stem Cell and Tissue Engineering, Dalian University of Technology, China. His main research interests include novel bioreactor and stem cells 3D culture; stem cell expansion and differentiation control; scaffolds and tissue construction; transport phenomena in micro/nano scale and enhancement; bioprocessing of bio-fuel etc. He has published more than 200 journal papers and more than 100 papers in proceedings of international conferences. He has edited 2 scientific books and as author in other 3 chapters of international books on Tissue Engineering and has 11 patents. He has been responsible for various national and international projects on transport phenomena and stem cell study.

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Notes:

Laura Floroian, J Biotechnol Biomater 2018, Volume 8
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Functionalized antimicrobial thin films for stainless steel implants coatings

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We report on the transfer of novel polymer-antibiotic-bioactive glass composites by matrix assisted pulsed laser evaporation to uniform thin layers onto stainless steel implant. Influence of the deposition process on the structure of nanomaterials was studied. The targets were prepared by freezing in liquid nitrogen of mixtures containing polymer and antimicrobial natural extract reinforced with bioglass powders. The cryogenic targets were submitted to multipulse ablation with a UV KrF* (λ=248 nm, t~25 ns) excimer laser source. The main advantages with this coating are multiple: stopping any leakage of metal and metal oxides to the biological fluids and finally to inner organs (by polymer use), speeding up osteointegration (by bioactive glass use), antimicrobial effect (by antibiotics use) and decreasing of the implant price (by cheaper stainless steel use). The behaviour of polymer-natural extract-glass/stainless steel structure in conditions which simulate the physiological environment was evaluated *in vitro* by complementary techniques. The bioactivity and the release of the antibiotics were assessed by immersion into simulated body fluid and monitoring by FTIR, UV-VIS spectrometry and electrochemical measurements involving corrosion and EIS studies, carried out in order to investigate the corrosion resistance. The biological properties were tested including the microbial viability using Gram -ve and Gram +ve bacterial strains, the microbial adherence and the cytotoxicity on eukaryotic cells.

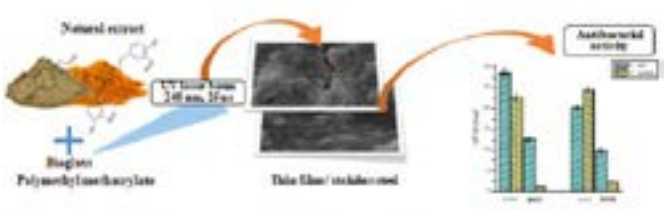

Figure 1: Obtaining of antimicrobial thin films onto stainless steel substrate by advanced laser techniques

Recent Publications

1. Floroian L, Craciun D, Socol G, Dorcioman G, Socol M, et al. (2017) Titanium implants' surface functionalization by pulsed laser deposition of TiN, ZrC and ZrN hard films. Applied Surface Science 417:175-183.
2. Floroian L, Ristoscu C, Candiani G, Pastori N, Moscatelli M, et al. (2017) Antimicrobial thin films based on ayurvedic plants extracts embedded in a bioactive glass matrix. Applied Surface Science 417:224-234.
3. Badea M, Floroian L, Restani P, Cobzac SC and Moga M (2016) Ochratoxin A detection on antibody- immobilized on BSA-functionalized gold electrodes. PLoS ONE 11(7):e0160021.
4. Floroian L, Ristoscu C, Mihailescu N, Negut I, Badea M, et al. (2016) Functionalized antimicrobial composite thin films printing for stainless steel implant coatings. Molecules 21:740-758.
5. Ciuca S, Badea M, Pozna E, Pana I, Kiss A, et al. (2016) Evaluation of Ag containing hydroxyapatite coatings to the Candida albicans infection. Journal of Microbiological Methods 125:12-18.

Biography

Laura Floroian received her BSc Degree in Physics at the University of Bucharest, Romania in 1995 and she is currently Associate Professor at Transilvania University of Brasov, Romania. Her current research interests cover biomaterials fields, optical sensor for cell detection, biosensors for biological compounds and toxic compounds, advanced techniques for thin films deposition and advanced techniques for surface characterization. She is a member of many scientific societies: SRF-Romanian Society of Physics, Romanian Society of Automation and Technical Informatics (SRAIT), National Society for Medical Engineering and Biological Technology (SNMITB) and International Association of Online Engineering (IAOE).

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Vanja Kokol et al., J Biotechnol Biomater 2018, Volume 8
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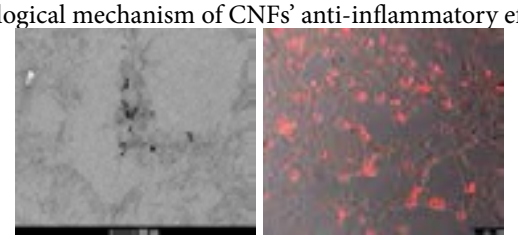
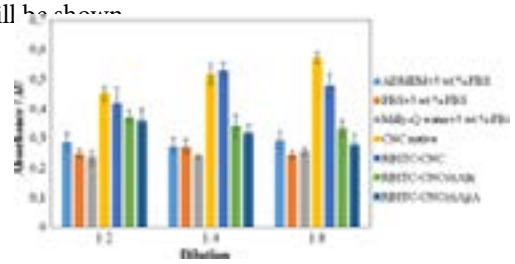
Cytocompatibility and immunomodulatory properties of nanocellulose for bone-tissue regeneration

Vanja Kokol[1], **Sergej Tomić**[2], **Miodrag Čolić**[2], **Selestina Gorgieva**[1], **Uroš Maver**[1] and **Lenart Girandon**[3]
[1]University of Maribor, Slovenia
[2]University of Defence, Serbia
[3]Educell Ltd., Slovenia

Nanocellulose (NC) has gained much attention recently for their use in pharmaceutical and biomedical applications (such as wound healing, tissue engineering, cell therapy, gene and drug delivery, and diagnostics) due to its large surface area, special mechanical characteristics, and generally-believed excellent biological properties. Out of the two main types of plant-based nanocellulose materials (cellulose nanocrystals (CNCs) and cellulose nanofibrills (CNFs), only CNFs possess a relatively low rigidity, thanks to the alternating crystalline (contributing to stiffness and elasticity) and amorphous cellulose structure (contributing to flexibility and plasticity), which significantly widens their biomedical applications. However, as the commercial applications of NC are approaching, the question about their safety and biocompatibility is also on rise. In contribution, the cytotoxicity as a key parameter of biocompatibility of CNF/CNCs will be presented and discussed depending on its structural properties (size, shape, assembling), surface chemistry, applied concentrations, study models, cell types and exposure time. The effect of NC labeling, being required to perform all the analysis, will be also taken into account. In addition, some studies on immunological mechanism of CNFs' anti-inflammatory effects will be shown.





TE and confocal microscopy images of RBITC-labelled native (1st line), and ApA modified (2nd line) CNCs after 1h of incubation with human osteoblasts.

MTT testing results (the absorbance intensity of formazan product measured at 570 nm) of osteoblasts incubated with differently diluted 0.5 wt% of CNCs.

Recent Publications

1. Gorgieva Selestina, Girandon Lenart and Kokol Vanja (2017) Mineralization potential of cellulose-nanofibrils reinforced gelatine scaffolds for promoted calcium deposition by mesenchymal stem cells. Mater Sci & Eng C, Materials for Biological Applications 73:478-489.
2. Gorgieva Selestina, Vivod Vera, Maver Uroš, Gradišnik Lidija and Dolenšek Jurij (2017) Internalization of (bis) phosphonate-modified cellulose nanocrystals by human osteoblast cells. Cellulose 24(10):4235-4252.
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4. Gorgieva Selestina, Vogrinčič Robert and Kokol Vanja (2015) Polydispersity and assembling phenomena of native and reactive dye-labelled nanocellulose. Cellulose 22(6):3541-3558.
5. Čolić Miodrag, Mihajlović Dušan, Mathew Aji P, Naseri Narges and Kokol Vanja (2015) Cytocompatibility and immunomodulatory properties of wood based nanofibrillated cellulose. Cellulose 22(1):763-778.

Biography

Assoc. Prof. Vanja Kokol PhD got a PhD in area of Textile chemistry in 2001 at University of Maribor, Faculty of Mechanical Engineering (UM-FS). She have been employed at UM-FS from 1994, currently as a research counsellor with the habilitation of Assoc. Prof.. Her research work in the last decade is oriented in modification and functionalization of fibers and biopolymers, and their processing in highly-engineered materials for different applications (from technical to biomedical). Special attention is attributed to the development of biopolymeric 2D and 3D materials with targeted and biocompatible antimicrobial activity. She is author of more than 90 papers, 3 book chapters, 3 patents, was supervisor of several (seven) doctoral and post-doctoral (five) students, and have been active in research programme Textile chemistry (from 1999) and Center of Excelence (from 2010) for advanced materials and technologies, area of Soft biomaterials. She was involved (leading or collaborating) in many national (ARRS-L2-7576, ARRS-J2-7018), bilateral (SLo-CZ, Slo-IT, SLO-IND, SLO-DE), international (E!3100 CAWAB, E!3654 BIOPOLS, EraNet Manunet NANOWEL, EraNet Matera Plus ANTIMICROB PEPTIDES, E!4956 MAGNET, EraNet MNT TABANA, EraNet MNT n-POSSCOG) and EU (H2020-PILOTS-03-2017-760601-2-NanoTexSurf, FP7-NMP-2011-SMALL-5-280519-NANOSELECT, FP7-NMP-2011-LARGE-5-280759-NANOBARRIER, Erasmus-Mundus (EMA2)-2013–2540/001–EUPHRATES, Marie Curie ToK/DEV FP6-MTKD-CT-2005-029540-POLYSURF, FP6-2004-SME-COOP-032877-ENZUP) funded research projects.

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Notes:

Young-A Son et al., J Biotechnol Biomater 2018, Volume 8
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Preparation of novel dye materials and application with supercritical CO_2 medium: Environmentally and health-friendly system

Young-A Son, Raju Penthala, Myeongjin Kim, Gisu Heo
Chungnam National University, South Korea

In the conventional-water based coloration methods, polymer and textile industries requires more amount of water for the coloration demands and also needs several chemical additives like dispersing agents and surfactants for enhancing the solubility of dye in water. Therefore eco-friendly purposes, related industry looking for environmentally and bio friendly process to replace the conventional-water based application method. In order to overcome, the biological, the ecological and economical disadvantages, super critical fluid dyeing process has been interested and introduced nowadays. In the supercritical fluid system, supercritical fluids were used as dye solvents instead of water. A supercritical fluid can be defined as a substance above its critical temperature (Tc) and pressure (Pc). Under these described conditions the substance has unique properties, in that it exists as a vapor and liquid in equilibrium. Carbon dioxide is particularly attractive due to its green properties like recyclable, non-toxic, biologically friendly and non-flammable advantages. Anthraquinone disperse dye molecules are plays a vital role in the coloration industry. These molecules are more stable under the experimental conditions and as well as in various organic solvents when during the calibrations. Molar absorption coefficients of anthraquinone dyes are allows spectroscopic determination even at very low concentrations. Series of anthraquinone blue dye derivatives have been designed and synthesized from available moieties with simple and convenient methods. Herein, anthraquinone dyes were synthesized, analyzed and fully characterized by ^{1}HNMR, ^{13}CNMR, UV-Vis and HRMS. The UV-Vis spectra of the dyes were indicated that the absorption wavelengths of the dyes were about bathochromic wavelength range, which shows that they were blue dyes. These new developed dyes can be considered as eco-friendly and biological friendly application system.

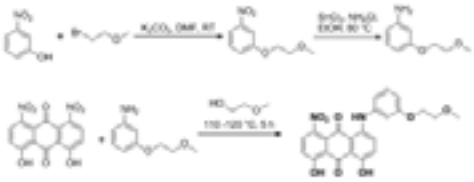

Figure 1. Demands on biologically and environmentally friendly application system

Figure 2. Design and preparation of new dye molecules towards biologically and environmentally friendly application system

Recent Publications

1. Kant R. Textile dyeing industry an environmental hazard. Natural Sci. 2012: 4: 22-6.
2. Tichonovas M. Krugly E. Racys V, Hippler R, Kauneliene V, Stasiulaitiene I, Martuzevicius D. Degradation of various textile dyes as wastewater pollutants under dielectric barrier discharge plasma treatment. Chem. Eng. J. 2013: 229: 9-19.
3. Ratna, Padhi BS Pollution due to synthetic dyes toxicity & carcinogenicity studies and remediation Int. J. Environ Sci 2013: 3: 940-955.
4. Handa BK. Treatment and recycle of wastewater in industry. National Environmental Engineering Re-search Institute, Nagpur. 1991: 21, 65, 75, 76, 78, 82, 85, 94.

Biography

Young-A Son is a professor in the Department of Advanced Organic Materials Engineering, Chungnam National University. His current research interests include luminescent organic materials, chemosensors, thermochromic dyes, color filter, functional dye materials and biosensors.

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Leila Karimi, J Biotechnol Biomater 2018, Volume 8
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Pegylated and amphiphilic Chitosan coated manganese ferrite nanoparticles for pH-sensitive delivery of methotrexate: synthesis and characterization

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Islamic Azad University, Iran

Magnetic nanoparticles (MNPs) are the major class of nanoparticles (NPs) with specific functional properties that make them good candidates for biomedical applications. Due to their response to the magnetic field, they can be used in targeted drug delivery systems. In current research, the MNPs were synthesized with the general formula of Fe1-xMnxFe2O4 by the co-percipitation technique. First, the effect of the Fe2+ ions in the system was investigated. Succinid anhydride was used as the first stabilizer to prepare surface for binding two types of polymer, including Polyethylene glycol (PEG) and palmitoylated polyethylene glycol-grafted (Cs-PEG-PA) were introduced as a polymeric shell. The composition, size, structure and magnetic properties of NPs were determined by the particle size analysis (PSA), X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR) and vibrating sample magnetometer (VSM). Determining the well-defined properties of MNPs, methotrexate (MTX), as a common anticancer drug, was encapsulated into the coated MNPs. The drug encapsulation efficiency was as high as 92.8 % with the magnetization value of 19.7 emu/g. The in-vitro release pattern was studied, showing only 6% of the drug release in pH= 7.4 (as a model of the physiological environment) and 25% in pH= 5.4 (as a model of the tumor tissue environment) after 72 h. Based on these results, we may be able to introduce this specific system as a novel pH sensitive MNP system for MTX targeting to tumor tissues in cancer chemotherapy.

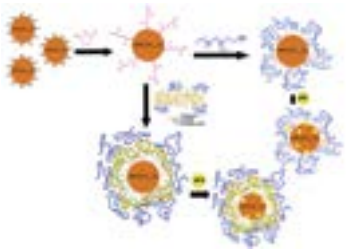

Figure1: Schematic illustration of coating and drug loading of manganese ferrite nanoparticles for pH-sensitive delivery of methotrexate

Recent Publications

1. Z. Karimi, H. Shokrollahi, L. Karimi, (2013) Nano-magnetic particles used in biomedicine: core and coating materials, Materials science and Engineering: C 33:2465–2475.
2. L. Karimi, H. Shokrollahi, (2011) Structural, micro structural and magnetic properties of amorphous/nanocrystalline Ni63Fe13Mo4Nb20 powders prepared by mechanical alloying, Journal of Alloys and Compound 509:6571–6577.
3. L. Karimi, H. Shokrollahi, Z. Karimi, M. Mohammadi, (2013) Improvement of magnetic properties of nanostructured Ni79Fe16Mo5 alloyed powders by a suitable heat treatment, Advanced Powder Technology 24:653–658.
4. Y. Mohammadifar, H. Shokrollahi, Z. Karimi, L. Karimi, (2014) The synthesis of Co1−xDyxFe2O4 nanoparticles and thin films as well as investigating their magnetic and magneto-optical properties, Journal of Magnetism and Magnetic Materials 366:44–49.
5. Z. Karimi, Y. Mohammadifar, H. Shokrollahi, Sh. Khameneh asl, L. Karimi, Magnetic and structural properties of nano sized Dy-doped cobalt ferrite synthesized by co-precipitation, Journal of Magnetism and Magnetic Materials 361 (2014) 150–156

Biography

Leila Karimi holds a BA in ceramic Materials. She received MA in Materials Science and Engineering by the Islamic Azad University with a focus in Magnetic Materials and Drug Delivery. Where she furthers her research on the magnetic materials physical concepts of ferrofluids, drug delivery, magnetic properties and synthesis methods of Nano sized ferrites to provide a suitable selection of magnetic core, surfactant layer and liquid type for influential cancer treatment

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Moises de Souza Gomes et al., J Biotechnol Biomater 2018, Volume 8
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A proposal for a technological roadmap of nanocellulose

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[2] EQ-UFRJ, Brazil

The search for increased value products from the commodity paper and cellulose industry found on nanocellulose – a high performance nanoscale biomaterial discovered by Turbak. Snyder and Sandberg in the ITT Rayonier Labs (New Jersey, USA) in 1978 – an opportunity to reach more profitable markets, such as advanced composites for the auto industry, flexible OLED screens, pharma formulations or advanced biomedical therapies. To understand the evolution of this 40-year technology, and the progress towards industry/commercial applications, the analysis of patent and scientific articles becomes a key information to future investments and efforts towards new nanocellulose-based frontier materials. The purpose of the present study is to propose a technological roadmap of nanocellulose to understand in which direction in which this technology is heading. Patent data search used Questel Orbit and Thomson Reuters' Derwent Innovation Index from Web of Science databases. Scientific articles search used Scopus and SciFinder databases. All gathered information was classified with the following hierarchy: 1. Type of nanocellulose (Nanocrystalline, nanofibrillated or bacterial nanocellulose; 2. Subject (Production process or chemical modification/application); and 3. Country of origin. This classification occurred after a detailed analysis of each searched document. A further analysis associated the documents with a target market/application, creating a table relating it with the type of technology used. The proposed technological roadmap was then created quantifying the tendencies with the industry investments, creating a most probable scenario of the future of nanocellulose and its applications for the mid and long term. Although the early use of nanocellulose, as nanofibrillated cellulose, focused on nanocomposites and their use as rheology modifiers, the new chemical modification methods of bacterial nanocellulose shifted the interest of this material on sophisticated biomedical applications, as well as to nanocrystalline cellulose, with high performance use in photonics and advanced electronics.

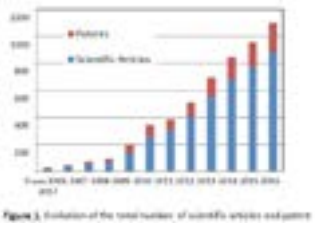

Figure1: Evolution of the total number of scientific articles and patent deposits/ granted patents from 2006 to 2017

Recent Publications

1. Oksman K, et al. (2016) Review of the recent developments in cellulose nanocomposite processing. Composites: Part A 83:2-18.
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3. Milanez DH, et al. (2013) Assessing nanocellulose developments using science and technology indicators. Materials Research 16(3):635-641.
4. Charreau H, Foresti ML and Vazquez A (2013) Nanocellulose patent trends: a comprehensive review on patents on cellulose nanocrystals, microfibrillated and bacterial cellulose. Recent Patents on Nanotechnology 7(1):56-80.
5. Klemm D, et al. (2011) Nanocellulose: a new Family of nature-based materials. Angewandte Chemie International Edition 50(24) 5438-5466

Biography

Moises de Souza Gomes is a patent examiner at the Polymer Division of the Brazilian Patent and Trademark Office and a Ph.D student on Polymer Science and Technology at IMA-UFRJ, under the advisory of Professor Maria Marques. His experience on the field of applied technology in the energy industry, especially renewables, led him to study alternative materials for the packaging and biomedical industry. He has led several projects with international corporations, institutions and government agencies in the field of chemistry and energy. With a B.Sc. in Chemical Engineer, and M.Sc. in Polymer Science and Technology, he has also expertise on technology, project and process analysis

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Notes:

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Biomaterials 2018

Shyh Shin Hwang, J Biotechnol Biomater 2018, Volume 8
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Improved mechanical, thermal and flame-resistant properties of PC/ABS/ montmorillonite nanocomposites

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Blends of polycarbonate (PC) and Acrylonitrile-butadiene-styrene (ABS) have a wide range of applications in various industries, such as automotive, machinery, electronics, and communication. In this study, PC/ABS extensively used in electronics and electrical equipment were used as the matrix to prepare composite materials. Environmentally-friendly inorganic flame retardants (magnesium hydroxide (MH) and a halogen-free phosphorus flame retardant additive (bisphenol A bis(diphenylphosphate)(BDP)) were added to PC/ABS. Layered silicate (montmorillonite (MMT)) was added to make nanocomposites. We used a high temperature type banbury mixer to prepare PC/ABS/MH/BDP/OMMT nanocomposites, which were characterized by various analytical techniques. The XRD results showed expansion in the distance between layers of MMT from 1.28 to 1.8 nm. The 5 types of prepared PC/ABS nanocomposites did not reveal characteristic peaks of MMT between 3° and 6° indicating that MMT dispersed in the nanocomposites. The thermal analysis indicated that either MH or BDP contributes to an increase in the char residue; adding two materials together provide a synergistic effect through increasing the char residue. The LOI value rose to 29 when two flame retardants were added, significantly higher than the LOI values when only one of the materials was used.

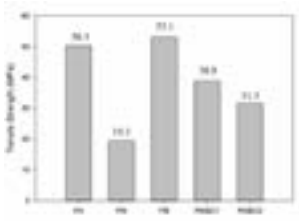

Figure 1: Tensile strengths of PC/ABS nanocomposites.

Recent Publications

1. S S Hwang (2016) Tensile, electrical conductivity and EMI shielding properties of solid and foamed PBT/carbon fiber composites. Composites Part B Engineering. 98. Doi: 10.1016/j.compositesb.2016.05.028.
2. W R Jong, S S Hwang, M C Tsai C C Wu, Effect of gas counter pressure (GCP) on shrinkage and residual stress for injection molding process. Journal of Polymer Engineering. 37(5):505-520.
3. M K Chang, S S Hwang, S P Liu (2014) Flame retardancy and thermal stability of ethylene-vinyl acetate copolymer nanocomposites with alumina trihydrate and montmorillonite. Journal of Industrial & Engineering Chemistry. 20(4):1596-1601.
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Biography

Shyh Shin Hwang is a Professor of Mechanical Engineering, Chien Hsin University of Science and Technology, Taiwan, and is in charge of the precise injection molding laboratory. He received his BS in Mechanical Engineering (Feng-Chia University, Taiwan), MS in Mechanical Engineering (Northeastern University, Boston, MA), and PhD in Mechanical Engineering from University of Rochester, Rochester, NY, USA. His research area is related to the microcellular, polymer/clay nanocomposites foam, over-molding, gas-counter pressure process, and water-assisted injection molding process.

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JNK-targeting regenerative nanoparticles for augmented elastic tissue repair in proteolytic disorders

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Proteolytic disorders involve chronic breakdown of elastic fibers by matrix metalloproteinases (MMPs). Adult cells are inherently deficient in effecting regenerative repair of elastic fibers. We previously showed that at low (<10 ug/ml) doses, doxycycline (DOX) inhibits MMPs as it does at much higher oral doses, but also stimulates elastic matrix neoassembly and crosslinking. In this work, we show that both these effects of low dose DOX are linked to its upregulation of transforming growth factor beta (TGF-β1) upon targeted inhibition of a regulatory protein c-Jun-N-terminal kinase 2 (JNK2). We also investigated if sustained and steady release of DOX from biodegradable polymer nanoparticles (NPs) we have developed that independently provide pro-elastogenic and anti-MMP effects, is able to synergistically improve quantity and quality (crosslinking, fiber formation and density, stability against proteolysis) in *in vitro* cultures of cytokine-activated rat smooth muscle cells from aortic aneurysms, a vascular proteolytic disease (EaRASMCs). Cytokine-activated EaRASMC cultures were treated with (1-20 ug/ml) or without DOX (treatment controls) and compared with cultures of healthy SMCs. Western Blots detected expression of JNK isoforms, pJNK, and TGF-β1 and outcomes were correlated with elastic matrix amounts, desmosine crosslinks, elastic fiber counts, MMP protein amounts and enzyme activities in the cell layers at 21 days of culture. Next, PLGA-PEG nanoparticles encapsulating DOX were formulated with pendant cationic amphiphile groups and shown to release DOX at the JNK inhibitory doses. Cytokine-activated EaRASMCs were cultured with the DOX-NPs for 30 min or 21 days. Healthy SMCs, and EaRASMCs cultured with blank NPs and no NPs served as controls and assessments were performed as in the earlier experiment. DOX inhibited expression and phosphorylation of JNK. Levels of JNK2 and pJNK, were lower in treated cultures and similar to healthy controls. JNK inhibition increased TGF-β1 expression and these outcomes were dose dependent & correlated positively to elastic matrix amounts, crosslinking and fiber counts and negatively to MMPs. DOX-delivery from the NPs more effectively in stimulated elastic fiber formation and crosslinking and inhibiting MMPs versus exogenous DOX. The results suggest that JNK inhibition is a useful metric to assess matrix-regenerative properties of DOX and emphasize synergy between DOX & our functionalized nanocarriers.

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Properties of bio-compatible polymers for 3d nanostructuring

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Two-Photon Polymerization (2PP) allows fabrication of arbitrary three-dimensional structures in the sub-micrometer range with controllable spatial and material properties. For 2PP a liquid resin consisting of cross-linkable monomers and a small amount of a photo initiator is used as matrix for writing. Femtosecond laser pulses and a high numerical aperture objective are used to create a focal volume with a high energy density. Therefor a simultaneous absorption of two photons by the photo initiator is probable. The excited photo initiator decays than into a chemical active radical, which starts the radical polymerization. Thus the cross-linking of the monomers yields the solidification of the polymer. Recent advances in three-dimensional nanolithography for tissue engineering requires for non-toxic materials mimicking tissue properties (eg. the extracellular matrix or cartilage). Typically for 3D lithography acrylate monomers are used because of their high reactivity. However, they are toxic. Up to now mostly methacrylates are used. However they are less reactive and therefore require a lower manufacturing velocity. In this work we present a new type of biocompatible polymer, which combines the reactivity of acrylates, the biocompatibility of methacrylates and the stability of thiols. The resins are structured using 2PP with a 515nm light source, a writing speeds up to several mm/s and sub-micrometer feature sizes. In order to characterize the mechanical properties of the manufactured scaffolds, atomic force microscopy (AFM) was used. The polymers Young's modulus have been characterized and compared to different available resins.

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Hemicelluloses as reducing and dispersing agents for fabrication of noble metals nanoparticles

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Statement of the Problem: The hemicelluloses are hetropolymers of reducing sugars having aldehydic group in equilibrium with the cyclic form; thus they can reduce noble metal ions to metallic particles and can disperse particles in their network. The metal NPs thus prepared are suitable for biomedical applications.

Methodology & Theoretical Orientation: Hemicelluloses are of great value for fabrication of metal nanoparticles (NPs) due to their reducing and dispersion power, hydrophilicity, low cost, high thermal stability and biocompatibility. Metal NPs of copper (Cu), silver (Ag) and gold (Au) were rapidly obtained after mixing the aqueous suspensions of hemicelluloses, isolated from various plant species with precursor metal salts. Effect of various parameters such as amount of hemicellulose, pH and temperature was optimized by response surface methodology using Design Expert®10.0.0 software.

Findings: The reduction of metal ions was observed by change in colour: yellowish to purple/blue/ruby red in case of gold or colourless to yellow/brown in case of silver, depending upon the temperature and pH, as monitored by recording the characteristic surface plasmon resonance (SPR) spectra in the 300-800 nm range. The synthesized NPs were spherical in shape and size of particles was determined by XRD, electron microscopy, dynamic light scattering techniques. The size was purely dependent on pH, amount of the hemicellulose and temperature of the reaction-mixture. The synthesized gold NPs were proved to be nontoxic as in cytotoxic tests.

Conclusion & Significance: The size of gold NPs (>30) obtained by certain hemicelluloses fits in the range which can hardly pass into the nucleus of cell, so they are suitable carriers for drug delivery. On the other hand NPs of silver and copper, showed dose-dependent antimicrobial and cytotoxicity activities, so have potential to be used as anti-cancer and anti-infective agents. Moreover, these types of biopolymers can be modified toward new functionalities with metals or biomolecules.

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Integration of dispersed SWCNTs in FETs by usage of pyrene functionalized alkanethioates

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Metal nanoparticles attached to carbon-based nanostructured materials enable new nanoelectronic solutions for energy storage (e.g. fuel cells, supercapacitors) [1] as well as in chemical, biochemical [1,2,4] and optical sensors [2,3,4]. A requirement for electronic sensors is the design of a versatile nanoelectronic transducer. In the ideal case, such a component can be functionalized with nanoscopic building blocks in a modular manner that allows selective response and tuning of the sensitivity. Nanoelectronic field-effect transistors (FETs) using individualized single-walled carbon nanotubes (SWCNTs) have been proposed for this case as FET channel material [5,6]. Recently, we presented a scalable on-chip functionalization approach for single-walled carbon nanotubes between palladium electrodes in the geometry of a field-effect transistor with preformed gold nanoparticles [5]. This method is wafer-level compatible and comprises two stages of flow chemistry. In a new chemical approach, we propose the deposition of SWCNTs by inkjet printing, followed by a microfluidic deposition of the nanoparticles. The concept for this type of FET channel is shown in the following schematic representation.

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An alternative production method for collagen to obtain scaffolds

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Background: Collagen is a basic structural element in native extracellular matrices, and its abundant presence in natural tissues, composing 30% by weight of body, protein tissues, predestines it as a polymer for biomedical materials and tissue engineering matrices. It is generally extracted from the natural tissues by treatments with acid or alkali, enzyme, and microorganisms. However, these methods are generally dependent on batch type and reactants, time and energy consuming, and highly costly methods. In this paper, we discuss an alternative method that could be applied on different tissues to extract collagen. It decreases the time and energy consumption and the usage of environment hazardous chemicals.

Methods: In this study, we developed an improved method that reduces the time needed to extract this protein and increase the efficiency. The results were compared with the one obtained from the traditional methods. The alternative method uses traditional extraction buffers combined with forceful agitation and centrifugal filtration to obtain highly-pure, soluble collagen extraction.

Results: This method is simple to perform using standard methods and equipment found in many laboratories. By employing high-speed agitation, this protocol reduces the time necessary to isolate solution, collagen extraction from approximately 7 days to less than 3 hr.

Conclusions: This paper indicates that these waste materials of animals have potential in supplementing the skin of land vertebrates as a source of collagen. The end product (collagen) could be used in many different applications, ranging from drug carrier systems to tissue scaffolds and reconstructive surgery.

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Electrospun fibromyalgia nanostructured and chronic scaffold pain based on thermoplastic urethane (TPU)/carbon nanotube (CNT) with enhanced neural cell differentiation and proliferation: The influence of CNT micro-morphology

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The use of electrically conducting materials for the fabrication of neural scaffolds has attracted great attention since these materials can easily simulate the inherent bioelectricity of neural cells. However, appropriate mechanical properties and flexibility together with surface biocompatibility are required. In the present work, scaffolds based on thermoplastic urethane (TPU) comprising 0, 1.5, 2.5 and 3.5 wt.% of carbon nanotube (CNT) have been fabricated via electrospinning, in order to study the effect of the degree of electrical conductivity of scaffolds upon cell behaviour. Morphological and mechanical characteristics of the scaffolds have been investigated using AFM, SEM, TEM and tensile assays. The cytocompatibility, proliferation and differentiation of rat mesenchymal stem cells (RMSC) have been studied using MTT assay, SEM micrographs and real-time PCR. Neurons transmit electrochemical signals throughout the nervous system. Signalling can be enhanced and directed by an external electric or electromagnetic stimulus by means of inducing circulating current within the body nervous system. For this purpose, the RMSC cultured scaffolds with different conductivity were exposed to an extremely low frequency pulsed electromagnetic field (50 Hz, 1mT). Electrical conductivity of scaffolds showed to follow percolation model with a percolation threshold near 2.5 wt.% of CNT, above which the conductivity increased sharply as a result of conductive physical networks formed by the CNT particles. The biological assays performed on CNT loaded scaffolds revealed higher enhancement of neural gene expression and differentiation for the samples stayed above the threshold implying the positive role of the state of conductivity for increasing the efficiency of the scaffold for the regeneration of damaged nervous system.

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Smarts composites for heavy metal removal from waste water

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The high consumption of metal contaminated water and food have been classified as causative agent of lungs, bladder and kidney cancers, muscular weakness, high blood pressure, skin liaisons, reproductive disorders, damage to blood vessels, appetite loss, vomiting, nausea, skin dermatitis etc. even when present at low dosages. Smart composites are the constituents of the engineered materials with desired size, which ultimately results in extraordinary physical and chemical properties, such as the unique optical, electrical, thermal and adsorption characteristics, etc., due to their ultra-small size. Large specific surface areas of smart composites can improve the detection sensitivity and miniaturize the devices in analytical procedures. In addition, these smart composites of various compositions, morphologies can provide powerful tools for the environmental devices and techniques. The present lecture will be focused on the heavy metal removal using smart composites from wastewater.

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Wheat straw lignin for value added by-products: A biofuel for future

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It is predicted that the world population will be increased to 9 billion by 2050. Therefore, the next energy goals of the 21st century must be to provide reasonable energy services for the comfort of all human beings. Among all sources of energies, renewable energies are anticipated to change the future of energy flows. Each year, half of the produced world biomass is lignocellulosic biomass, which has a weight of around 10-20 billion dry tons. While lignin can be efficiently used in pharma and food sectors, it is burnt to produce heat and recover pulping chemicals in paper mills industry. In this study, high purified lignin was extracted by organosolv method from wheat straw. During the extraction process, no catalysts were applied; therefore, the carbohydrates impurities caused by acids were the least. On the other hand, all the ethanol applied in the process was recovered. So, the extraction was done with the minimum amount of solvent and energy. The extracted lignin was characterized by NMR, and FTIR. Moreover, the extraction was done in the bigger facility (20 L Parr reactor) for mass production. Furthermore, the biodegradation of lignin by *Bjerkandera adusta* was investigated. In the FTIR spectrum, existence of different lignin bonds including C-C, C=O, C=C, and aromatic rings were confirmed. Same groups were observed in the C-NMR spectrum. Also, the presence of carboxylic acid, aldehyde, phenolic hydroxyl, aromatic rings syringyl, and guaiacyl units were determined. The growth of *Bjerkandera adusta* on PDA culture media consists of 2% extracted lignin, making this fungus a good candidate for lignin biodegradation. These characteristics give the wheat straw lignin a good scope to be applied as a renewable polymer.

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Soft pulsed laser technologies for the transfer and processing of organic and biological/vivid materials

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Basic principles of laser pulses interaction with solid and liquid materials using advanced pulsed laser technologies are introduced and new recent results in synthesis of biomaterial layers are reviewed. Selection by combinatorial pulsed laser deposition of silver-doped carbon structures with reliable physical-chemical characteristics and high efficiency against microbial biofilms is presented. In-vitro biological assays were carried out using a large spectrum of bacterial and fungal strains, *i.e. Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Enterococcus faecalis and Candida albicans*. The biocompatibility of the films was evaluated on MG63 mammalian cells. The optimal combination with reasonable physical-chemical properties, efficient protection against microbial colonization and beneficial effects on human cells was found for silver-doped carbon films containing 2 to 7 at.% silver. These mixtures can be used to fabricate safe and efficient coatings of metallic implants, with the goal to decrease the risk of implant associated biofilm infections which are difficult to treat and often responsible for implant failure. In our opinion, these characteristics recommend the films with more than 2 and less than 7 at.% Ag concentration as the best compromise for the development of a new generation of smart coatings for orthopedic, cardiology or dental implants. Combinatorial - matrix-assisted pulsed laser evaporation was applied to synthesize crystalline gradient thin films with variable composition of Sr-substituted hydroxyapatite and zoledronate modified hydroxyapatite. The inhibitory action of zoledronate on osteoclast viability and activity is more efficient than that of Sr, which however plays a greater beneficial role on osteoblast proliferation and viability. The technique allows to modulate the composition of thin films and hence the promotion of bone growth and the inhibition of bone resorption. Thin films prepared by pulsed laser techniques are identical in chemical composition, structure, morphology, and most likely functionality resembling the base material, as proved by physical-chemical characterization and in-vitro testing. Combinatorial methods open the possibility to combine and immobilize two or more organic materials on a substrate in a well defined manner by laser evaporation under protection.

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In situ adhesion switching on non-symmetrical hydrophobic-superhydrophobic patterned surfaces for droplets transfer

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Hydrophobic-superhydrophobic patterned surface was fabricated on copper surfaces by site-selectively oxidation using ink masking and subsequent surface energy reduction. Anisotropic sliding of droplets on typical non-centrosymmetrical hydrophobic-superhydrophobic patterns such as semicircle, line segment and V-shaped line patterns was observed. Pattern dimensions (semicircle diameter, line segment length and V-shape angle) were designed to control the sliding anisotropy. Experimental data on sliding adhesion was in good agreement with the calculated data using classical drag-adhesion model (Furmidge equation). Taking advantage of the anisotropic sliding adhesion, the non-centrosymmetrical pattern can be used as a "mechanical hand" to *in situ* capture and release micro droplets by simply moving the pattern in different directions. The hand can capture a droplet pinned on a dot by lifting the pattern after touching the droplet. Meanwhile, the hand can also release the droplet simply by horizontally moving the pattern in low-sliding-adhesion direction. Due to the hydrophobicity of those patterns, the droplet can be handled by this mechanical hand without mass loss. The ability of switching droplet handling functions (capture and release) using simple linear motions would facilitate the development of practical applications for droplet-based reactors in biomedical domains.

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Numerical simulation of the femur fracture for different cemented hip femoral prosthesis under forces during stumbling

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Biomechanics is the study of the structure and function of biological systems by means of the methods of mechanics. Finite element analysis is a computer based numerical analysis method which can be used to calculate the response of a model to a set of well-defined boundary conditions. Hip total prosthesis was used for the patients who has the hip fracture and unable to recover naturally. To design highly durable prostheses one has to take into account the natural processes occurring in the bone. In this paper, the static load analysis is based by selecting the peak load during the stumbling activity. Two different implant materials have been selected to study appropriate material. The results showed the difference of maximum von Mises stress and detected the fracture of the femur shaft for different model (Charnley and Osteal) implant with the extended finite element method (X-FEM), and after the results of the numerical simulation of X-FEM for different was used in determining the stress intensity factors (SIF) to identify the crack behavior implant materials for different crack length. It has been shown that the maximum stress intensity factors were observed in the model of Charnley.

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From land to brand, working across a complex value chain - overview of Covestro's latest developments in bio-based cross linkers

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Sustainability is increasingly impacting on the purchasing decisions of customers, brand owners and consumers. Therefore, Covestro has early decided to embark into bio-based materials and thus to develop a new bio-based diisocyanate, namely the pentamethylene diisocyanate (PDI). This is the first diisocyanate with a significant renewable content based on a raw material produced via a highly efficient fermentation process directly from biomass. Utilizing the cost and energy effective gas phase technology to produce the isocyanate results in a highly sustainable product with 70% bio-based content and double digit reduction of carbon foot print equivalent. Based on this new building block Covestro launched in 2015 the first bio-based polyisocyanate Desmodur® eco N 7300, a new solvent-free aliphatic polyisocyanate which is able to match the high performance requirements of automotive OEM coatings. In 2017 a further milestone has been achieved: the development of hydrophilic PDI-based polyisocyanate - the Bayhydur® eco 7190, will allow the formulation of 2K waterborne polyurethane coatings with increased renewable content and lower VOC. Both new developments allow increasing renewable content of solvent-borne and water-borne high performance polyurethane systems with low carbon footprint, satisfying current and future requirements from the coatings market. Covestro would like to provide the audience with a brief overview about our experiences with the launch of these new bio-based polyisocyanates.

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Effect of natural waxes and surfactants on mechanical, optical, thermal and water vapor permeability of banana flour composite films

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Banana flour edible film has shown potential as good selective barriers to gas and UV light due to its natural chemical compounds (starch, protein, lipids and fibers). Nonetheless, the hydrophilicity of the biodegradable banana flour film showed poor resistance to water vapor and limit the application. To improve this drawback, the addition of each natural wax (beeswax; BW and carnauba wax; CW) and surfactant (stearic acid; SA and Tween-80; TW) at different ratios of wax and surfactant (20:80, 50:50 and 80:20 w/w) was investigated on banana composite film properties. As shown, the addition of wax and surfactant changed the microstructure of the film and also decreased the mechanical properties of films compared to the neat banana flour film. In addition to the hydrophobicity of wax, the compatibility of components added also played a major role on the film thermal and water barrier properties. CW had a higher degree of hydrophobicity than BW, however, the films containing CW showed lower effectiveness in water vapor barrier. This might be attributed to its incompatibility with the hydrophilic polymer resulting in the presence of some small voids and agglomerated particles on the surface of the film as shown in the SEM micrograph. Nevertheless, the best candidate of the banana flour composite film incorporated with BW: SA at a ratio of 50:50 showed 12% reduction in the water vapor permeability compared to the control film. Therefore, the banana flour composite film might be considered as a bio-based food packaging material and edible coating as alternative green food packaging application.

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FIB-SEM and HRTEM investigations of microstructure of chalcopyrite CuAlS2 thin films

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We investigate the microstructure of chalcopyrite $CuAlS_2$ thin films deposited on silicon (111) substrate. The polycrystalline films with different preferred grain orientations are grown by thermal evaporation from pure powder of synthesis deposited in elemental sources. The $CuAlS_2$ films were analyzed using focused ion beam scanning electron microscopy (FIB-SEM) and high-resolution transmission electron microscopy (HRTEM). FIB-SEM cross-section images reveal that the irregular-shaped particles are embedded in the film and that the surface region and the bulk are structurally similar, with no ordered defect chalcopyrite structure. However, their composition is slightly different, indicating that they can have different point defects. Microstructure properties of the films using HRTEM highlight grains in (112) textured films with sharp contrasts at the grain boundaries, whereas grains in (220/204) textured films give only weak contrasts indicating a preferential population of electronically rather inactive grain boundaries. Non-chalcopyrite ordering of the metal atoms in $CuAlS_2$ is observed by HRTEM, which is identified as a CuAu-type ordering. Sharp spots in electron diffraction patterns show the ordered Cu and Al atomically planes alternating along the [001] direction over a long range. The CuAu-ordered structure coexists with the chalcopyrite ordered structure, in well agreement with theoretical prediction. This study shows that dual beam FIB-SEM technique turns out to be an easy, less time consuming and useful method to characterize the crystallites of $CuAlS_2$ films in cross-section view, compared with the results obtained by HRTEM.

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Extended spectrum beta-lactamase in clinical isolates of *Escherichia coli* and *Klebsiella pneumoniae* from the Tamale teaching hospital

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Extended spectrum beta-lactamase (ESBL) producing Escherichia coli and Klebsiella pneumoniae are pathogens of significant public health interest to which new antibiotics therapies are urgently needed. This study was designed to determine the prevalence of ESBLs in clinical isolates of E. coli and K. pneumoniae from patients attending the Tamale teaching hospital (TTH). A total of 140 isolates of E. coli (83.6%; n=117) and K. pneumoniae (16.4%; n=23) were cultured from clinical specimens of consenting patients. Antimicrobial susceptibility was determined using the Kirby-Bauer disc diffusion method. Screening and confirmation for ESBL-producing phenotypes among the clinical isolates were performed according to the guidelines of the Clinical and Laboratory Standard Institute, 2012. Escherichia coli and K. pneumoniae positive for ESBL phenotype were examined for the presence of TEM, SHV and CTX-M genes. Sixty two (44.3%) of the 140 isolates expressed ESBLs phenotypically. Of these, 83.9% (n=52) were E. coli and 16.1% (n=10) were K. pneumoniae isolates. The proportion of ESBL-producing isolates were found to be relatively higher in adults (15-65 years) than in neonates (<28 days) [p=0.14]. Majority of the isolates showed high percentage resistance to ampicillin (96%) and tetracycline (89%), but relatively low resistance for amikacin (36%). None of the isolates were resistant to meropenem. The ESBL producers were multidrug resistant compared to non-ESBL-producers (23%, n=14/62 versus 18%, n=14/78; p=0.573). Overall, 74.2% (n=46/62) of the ESBL genotypes expressed BlaCTX-M-1 genes followed by 62.9% (n=39/62) BlaTEM and 16.1% (n=10/62) BlaSHV. Two (3.2%) isolates had both TEM and SHV genes, 29 (46.8%) harbored TEM and CTX-M-1, 2 (3.2%) had SHV and CTXM-1, while 4 (6.5%) harbored all three genes. None expressed genes for CTX-M 2 and CTX-M 9. In univariate comparisons, patients who reported their previous medication as having being prescribed by a Physician and those who reportedly completed their previous medication were more likely to be infected by ESBL organisms. The study showed high ESBL positive E. coli and K. pneumoniae, mostly CTX-M-1 producers in Tamale teaching hospital. Routine laboratory ESBL detection is warranted.

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Biomaterial based toxic gas sensor using microwave resonant cavity

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Biomaterials are getting significance in the current research field of gas sensors due to great sensitivity. Performance of biomaterial based gas sensor constructed from gum Arabica and garlic extract in microwave resonant cavity had been investigated. It is shown that extract of garlic clove with multiple medicinal and chemical utility is very helpful in sensing oxide gas. The material under observation undergoes some momentary physical change on exposure to oxide gas. This change can be detected over amplified potentiometric variation through electrical circuitry of microwave resonant cavity. Manipulating this appropriate characteristic a potentiometric gas sensor of faster response and recovery time can be designed. Sensing property of the said material has been studied via microwave attenuation, reflection, and transmission.

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Laser printing of biomaterials and living cells

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In this lecture, we discuss laser based techniques applied for precise generation of 3D scaffolds for tissue engineering and for printing biological cells into 3D patterns. For the scaffold generation, two-photon polymerization (2PP) technique is applied, which allows writing CAD structures directly into the volume of photosensitive polymer solutions. Scaffolds from different biomaterials like organic-inorganic Sol-Gel-Composites (e.g., zirconium-hybrids), biodegradable polymers (e.g., polylactic acid (PLA), polycaprolactone (PCL), polyethylene glycol (PEG)), and hydrogels (e.g., gelatin, hyaluronic acid, chitosan, alginate, gellan gum) or hydrogel blends, have been generated with this technique. For arranging cells in 3D patterns, laser-assisted bioprinting (LAB) based on the laser-induced forward transfer process is used. Different cell types, including primary cells, stem cells, and iPS cells embedded in hydrogels as extra-cellular matrix, have been printed. Both 2PP and LAB techniques are capable of advancing 3D cell culture towards CAD defined and precisely arranged 3D cell models and organ-on-chip systems. Printed tissue, for example skin, can be used for analyzing the effect of agents like pharmaceuticals or cosmetics *ex vivo* and by applying human primary cells it might be applied instead of animal tests.

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Biosensors for toxicity determination of organophosphates and carbamates in the human blood

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The advent of green revolution ensured improved agriculture production of the country but the excessive use of synthetic chemicals known as pesticides over the crops resulted in environmental contamination and posed incredible risk to human population. These harmful chemicals due to persistence in the environment meddle in the neurotransmission process of an individual during synapses process. Hence their analysis and detection is of significant concern today. Conventionally, chromatographic and spectrophotometric strategies utilized for the pesticide recognition have a few impediments so there is a need to develop some efficient sensor that can intelligently detect the pesticide genre and prevent us from intake of harmful chemicals. This need pulls our consideration towards the study of biosensors that can help the common people for their bio sample tested for contamination detection. This paper highlights the real time detection of major class of pesticides such as organophosphates and carbamates that inhibit the enzyme acetylcholine esterase, an essential constituent of neurotransmission process for hydrolyzing acetlcholine into choline and acetic acid in the human blood utilizing biosensors due to their exceptional characteristics to reduce the risks caused by these harmful chemicals. Biosensors have turned out to be a conservative device in the fast acknowledgment of poisonous chemicals by simplifying sample collection, extraction and cleanup methods. A variety of cholinesterase biosensors have been discussed based on affinity and catalytic based interactions for recognition of organophosphate and carbamate poisoning.

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Synthetic vectors and mechanical-biological approach to optimize the use of stem cells in neurodegenerative medicine

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PAMs1 are polymeric, biodegradable, biocompatible microcarriers providing a biomimetic 3-dimensional surface to enhance stem cell response for neuroregenerative medicine. MIAMI cells, that can be differentiated towards a neuronal phenotype on a LM surface and secrete many repair factors are candidates of choice for cell therapy studies. Recently, it has been shown that PLGA and PLGA-poloxamer188-PLGA composed particles that are surface functionalized with proteins present in the ECM, can improve stem cell response. MSCs located on the surface of PAMs composed of PLGA-poloxamer188-PLGA with a fibronectin surface survived 7 days longer than on the surface of PLGA. However, it still remains unclear how the chemical and physical microparticle surface properties, as well as protein adsorption influence cellular responses. Our results indicate that the 60 µm PLGA-poloxamer188-PLGA microcarriers have a granular surface and present a rough topography compared to the PLGA microcarriers that have a smooth surface with the presence of holes with variable sizes. The microcarriers exhibit a negative surface charge, and after coating with LM combined with PDL, positive surface charges were acquired for both types of polymer. According to our confocal microscopy results, the coating of the LM is more intense and the distribution tends to be more homogeneous on PLGA PAMs, compared to that seen with the PLGA-poloxamer188-PLGA composed of various spots. LM adsorption is decreased by the presence of the poloxamer188 (hydrophilic polymer), but is enhanced on the PAMs composed of PLGA (hydrophobic polymer) alone, and possibly PDL also influences the adsorption of LM on these surfaces. The MIAMI cells adhered and presented a flattened morphology on the surface of LM PLGA PAMs. In comparison, the MIAMI cells adhered less well and remained round on the surface of LM PLGA-poloxamer188-PLGA PAMs, which maybe is explained by the low adsorption of LM on these surfaces. Survival at 24 hours was lower on PLGA-poloxamer188-PLGA PAMs compared to PLGA PAMs and differentiation analysis is underway. In conclusion, the chemical composition and the wettability of microspheres significantly influence the adsorption of the ECM molecules. Consequently, this factor, in addition to the surface topography has an effect on the adhesion and subsequent behavior of MIAMI cells on their surfaces.

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