CNEN's TECHNOLOGY SHOWCASE

The results of our R&D activities are reflected in our intellectual property portfolio. Our assets comprise patents, industrial designs, trademarks, computer programs (softwares) and know-how secrets.
Here you can find some of our patented and software technologies, including the maturity level of each technology towards complete operation and full commercial deployment, measured by the Technology Readiness Level-TRL (Scale ranges: TRL 1 is the lowest and TRL 9 is the highest).

CNEN Comissão Nacional de Energia Nuclear

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO

GOVERNO FEDERAL
BRASIL
UNIÃO E RECONSTRUÇÃO

POLYURETHANE THERMOPLASTIC FILMS WITH POLYCARBONATE BASE FOR APPLICATION AS BIOMATERIAL

Problem

The increase in aging population, a group who is less likely to receive organ donations, and biomaterials for surgeries due to accidents, trauma injuries and chronic diseases are the key drivers for the search of new alternatives. Biomaterials containing thermoplastic polyurethane (TPU) films have the potential to last a lifetime (less rejection and calcification).

Solution

A method for polymeric thin film fabrication from thermoplastic polyurethane for application in organ and tissue repair. The method comprises three steps: preparation of a polymeric gel by treating the thermoplastic polyurethane, previously sterilized by ionizing radiation, with organic solvents; producing plate films via casting technique by adding boron silicate; and producing films in molds via dipping technique using an ultrasound bath to reduce bubbles in the film.

Competitive Chart

Biomaterials have a strong growing market due to their durability, flexibility, elasticity, biocompatibility and longevity characteristics. Biotechnology R&D laboratories or services in the medical sciences represent the main industry segment. Medical applications include catheter, tubing, surgical drapes, bedding, wound dressings, injection mold devices, and short-term implants, as well as emerging uses such as artificial hearts, feeding tubes and drains.

Stage of Development

TRL 3 – technology in the stage of experimental proof of concept with studies and test, in special scanning electron microscopy of TPU films subjected to 15 kGy, 25 kGy and 50 kGy.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.52466/ijamb.v4i1.97
Pat. numbers: BR 10 2018 003949-0 and BR 13 2021 016674-5
Related pat. Number: BR 10 2015 032289-5

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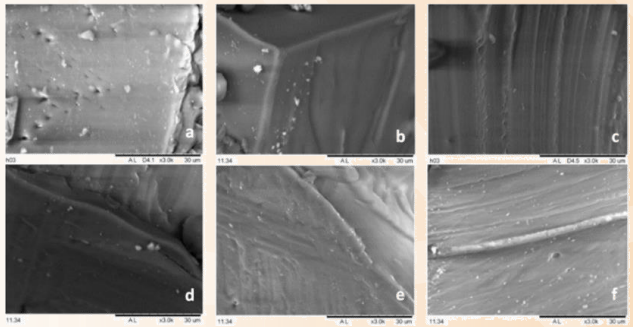

A NEW GRAPHENE SYNTHESIS PROCESS USING A PHOTO-OXIDATION METHOD ASSISTED BY ULTRAVIOLET RADIATION

Problem

Large scale and high reproducible processes coupled with environmentally sustainable processes to convert graphite into graphene are still the biggest challenges. In the conventional chemical reduction process of graphene oxide (GO), strong acids and oxidizing agents are used, which leads to hazardous toxic waste.

Solution

The technique of photo-oxidation by UV irradiation of a graphite dispersion, at room temperature, appears as a solution to overcome the disadvantages associated with the synthesis of graphene-based materials, with high quality, few defects, high yield, environmentally friendly and low cost. The synthesis process results in reduced graphene oxide (rGO) nanosheets.

Competitive Chart

The global graphene market is growing rapidly due to the promising properties of graphene, such as high thermal and electrical conductivity, flexibility and high mechanical resistance, and increasing investments in graphene production. Brazil is the third largest producer of graphite in the world. Products found in the competitive landscape for rGO or GO are in the form of paper, film and powder. There are many industries with potential applications for this technology, from plastics to electronics and textiles.

Stage of Development

TRL 3 to 4 – technology between experimental proof of concept and validation through analysis of operation parameters to enhance GO properties. Tests were already conducted to characterize the nanosheets (morphology, surface analysis by XPS). Tests for finding GO applications are in course with fuel cells and water decontamination with pharmaceuticals.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1080/09593330.2022.2163708
Pat. number: BR 10 2020 009121-2 and PCT BR 2021 050188

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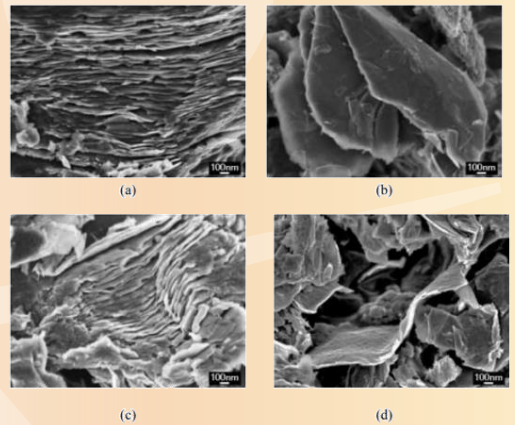

PROCESSES TO INCORPORATE FUNCTIONALIZED GRAPHENE-BASED NANOCOMPOSITES WITH BIOPOLYMER IN BIOLOGICAL TISSUES THAT CONTAIN COLLAGEN TYPE 1 AND MODIFIED BIOLOGICAL TISSUES OBTAINED THEREOF

Problem

The increase in aging population and high prevalence of cardiovascular diseases and neurological and orthopedic disorders are the main drivers for launching new products and highlight the advantages of biomaterials as implantable products for advancements in medical technology. Biomaterials play a vital role in heart valve and orthopedic surgeries (knee and tendon replacements in the latter). Graphene oxide (GO) is a graphene-based compound with promising medical applications as coating in tissue engineering for bioprosthesis due to its hydrophilicity and biological interactions with nanomaterial.

Solution

Two unique processes (a physical one via adsorption applying ultrasound and a chemical reaction with condensing agents and an acid) for incorporating graphene-based nanocomposites functionalized with biopolymer in biological tissues that contain collagen type 1. Modified biological tissues with enhanced mechanical properties. Both processes are versatile and differentiated, and the biological tissues are biocompatible and have no cytotoxicity.

Competitive Chart

The global biomaterial market is very attractive, and the technology is well positioned due to its differentiation. Orthopedic manufactures (foot appliances), surgical manufacturers (implants) and prosthetic supplies manufactures represent the industry segment in target. Companies producing bovine pericardial (BP) patches for cardiac and vascular repair, with various tissue engineered improvements, are potential opportunities. Concerns about the potential toxicity of graphene and its derivatives for biomedical use are overcome by this technology that combines them with other molecules, altering their characteristics, improving their compatibility and decreasing their toxicity.

Stage of Development

TRL 5 – technology validated through mechanical tests of body proofs of BP containing GO-PEG-NH2 (graphene oxide functionalized with amino polyethylene glycol) via adsorption (A) and chemical reaction (B). Valves containing GO-PEG-NH2 were also delivered to the Heart Institute/BR for tests. Experiments with this biopolymer incorporated in human tendons and mechanical tests are in progress. Oligochitosan is another biopolymer for tests (functionalized with GO and incorporated into the tendon collagen). Surface characterization by atomic force microscopy, mechanical tests and application in human tendons were conducted. A new patent application is likely to be filed.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.15392/bjrs.v7i3.837
Pat. number: BR 10 2018 067466-8

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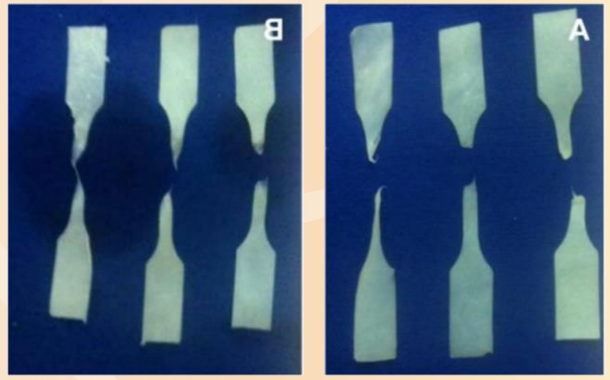

SOL-GEL METHOD FOR MANUFACTURING METAL MICROSPHERES WITH CUSTOMIZED POROSITY

Problem

Current processes for manufacturing stainless steel microspheres require high temperature iron ore pelletization, resulting in the fusion of raw material for shaping the desired microspheres or the ore pellets. Sol-gel processes represent an alternative for producing microspheres with customized size and nanostructure. Nanostructuring favors the formation of metallic spheres, oxides or metal oxides at temperatures below the melting point of the customized composition, making the production process less costly.

Solution

A scalable, low temperature sol-gel process for manufacturing monodispersed xerogel metal microspheres with customized porosity, tunable size, a narrow size distribution, and adjustable composition. Subsequent treatments can be added to tune the final material. These treatments include adsorption and precipitation of Fe, Cr and/or Ni to adjust the composition of stainless-steel microspheres, or high temperature thermal treatments under appropriate atmosphere to obtain cermet (for example, UO2-stainless steel).

Competitive Chart

Sol-gel processing for industrial applications, and precisely structured microspheres of various compositions, are both markets of high interest and strong growth. Microspheres and sol-gel processing are both experiencing strong demand across multiple end-use industries, with increasing applications in medical science (biomedical applications), coating and thin-film. Ferroalloys and specialty chemicals manufacturers represent the industry segment in target. Attractive aspects of the technology, such as low synthesis temperatures and higher purity end products, provide a distinct advantage.

Stage of Development

TRL 4 – technology validated through analysis of the microsphere parameters (porosity, diameter and sphericity). Three samples were characterized: UO2 coated with stainless steel coherent layer, porous stainless steel and UO2 -stainless steel cermet pellet. Technology also demonstrated in laboratory scale, with potential reproducibility in a pilot or industrial scale.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1155/2023/3555763
Pat. number: BR 10 2019 009124-0

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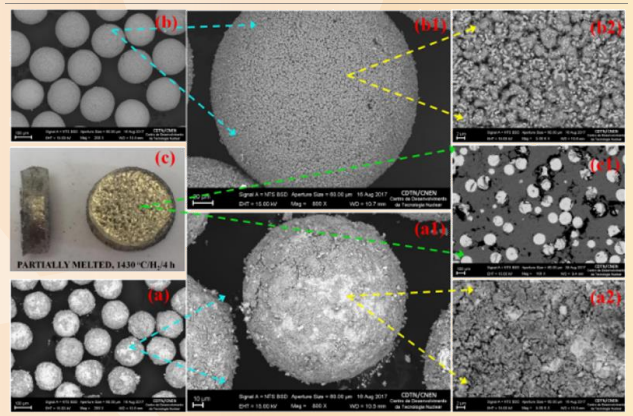

SYNTHESIS OF RADIOACTIVE AND NON-RADIOACTIVE GOLD NANOPARTICLES FOR DIAGNOSIS AND THERAPEUTIC USE

Problem

Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths. Mortality can be significantly reduced if cases are detected and treated as earliest as possible. Cancer treatments, such as chemotherapy, radiotherapy or surgical removal of tumor masses, may also fail due to insufficient action specificity or ineffectiveness. Theranostics combines cancer diagnosis and therapy, aiming for early diagnosis, accurate molecular imaging, and precise treatment at the right timing and proper dose, followed by real-time monitoring of treatment efficacy. Gold nanoparticles for diagnosis and therapeutic have the potential to overcome these hurdles in the medical field due to its features and benefits, in special the nanoparticle size that facilitates its penetration into the tumor vasculature, delivering the radiation dose directly to the target.

Solution

Gold nanoparticles (AuNP) are synthesized by chemical reduction of high pure metallic gold using reducing and stabilizing agents. Their use coupled with radiation of a targeted tissue (such as radiotherapy) results in a multiplier effect that allows an enhanced initial dose. In addition, radioactive golden nanoparticles (198AuNP) activated in a research reactor further contribute to the destruction of the target tissue.

Competitive Chart

Cancer diagnostics and therapy market have a growing attractiveness. The industry segment is composed by manufacturers of diagnostic and treatment substances and systems and healthcare settings (hospitals, treatment center and research labs). highly practical and useful for the medical field.

Stage of Development

TRL 4 – technology validated through analysis of the nanoparticle parameters (size, toxicology and cellular citotoxicology). In addition, pre-clinical tests in mice of the Balb/C NUDE lineage evaluated the therapeutic efficacy of the nanoparticles, resulting in a positive regression of the tumor growth (photo below).

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.3390/nano12020187
Pat. number: BR 10 2020 007225-0

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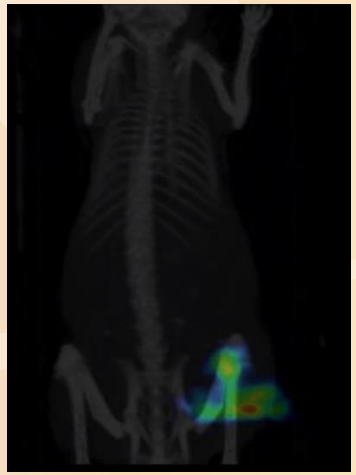

DIGITAL PULSE PROCESSING ALGORITHMS FOR POSITRON EMISSION TOMOGRAPHY

Problem

Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths in 2020. Cardiovascular disease is another top cause of death (an estimated 32% of all deaths worldwide). Around 50 million people have dementia, and there are nearly 10 million new cases every year. It's one of the major causes of disability and dependency among older people. Mortality can be significantly reduced if cases are detected and treated as earliest as possible. Positron emission tomography (PET) technology is used in the analysis of biochemical processes in humans and animals. Clinical applications of PET include cancer diagnosis and brain and heart studies. PET also has preclinical uses, such as in drug development and pharmacological studies. Traditionally, pulse processing in positron emission tomography (PET) has been based on analog or discrete circuits forming a decentralized processing system.

Solution

High-tech instrumentation for an AI-powered PET scanner with time-of-flight (ToF) capability to enhance image quality and reduce costs through lower acquisition time and amount of administered radiopharmaceutical. Field Programmable Gate Array (FPGA) data processing devices can provide fast implementation at relatively low cost and allow the development of sophisticated digital pulse and 3D positioning processing algorithms to improve energy, position and time resolutions in PET systems.

Competitive Chart

A positive landscape shows a growing market, a global focus on innovation and a cost competitive solution. The global market for molecular imaging, brain mapping instruments and PET systems and devices experiences moderate to high growth. Medical equipment manufacturers (in special PET scanner) and specialized integrated circuit manufacturers, as well as hospitals, medical research institutions and clinics represent the industry segment.

Stage of Development

TRL 5 – technology was spun off to a technology-based small company. Validation of a semi-integrated system after the tests and with a single detector block and a third-party digitizer board. A digitizing board was developed by the company to be evaluated. The processing algorithms were developed as a software to be shipped and tested on the digitizing board. With the conclusion of the detector block tests, a complete PET system will be composed to be demonstrated (TRL 6).

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1088/1748-0221/13/09/P09024
https://doi.org/10.1016/j.nima.2016.09.029
https://doi.org/10.1109/NSSMIC.2012.6551596
Pat. numbers: BR 10 2012 010830-5 / BR 10 2022 013063-9 / PCT BR 2013 039073

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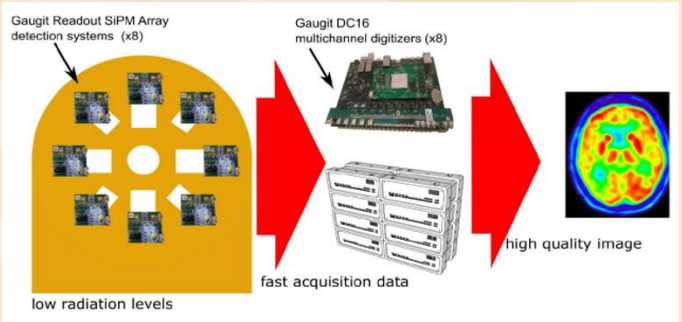

RADIOPHARMACY VIRTUAL SIMULATOR

Problem

Training in the nuclear field can be limited by restricted access to specialized equipment and hazardous materials due to ionizing radiation. In addition, safety and effective methods for performing tasks in this environment are important. Virtual Reality (VR) is widely used in academic, industrial, medical and military applications. In nuclear medicine, it is important to train professionals in detecting the total dose of radiation received by the workers, allowing an assessment of the performance and the radioprotection measures that are being put into practice. Nuclear medicine clinics and radiopharmacies can take advantage of VR for simulation and training of professionals, as well as to assist layout and ergonomic projects.

Solution

A radiopharmacy VR simulation comprising objects and equipment, their descriptions and use (some of the objects may be manipulated to simulate procedures performed by the professional); the physical space representing the location and the sequence of tasks being performed; the information related to the ionizing radiation dose in each position in the environment and the total dose of explosion of the professional in his normal activities. In addition, a computer software was developed.

Competitive Chart

VR applications in healthcare are experiencing an explosive growth. Demand for VR training and a focus on innovation are the promising features for market entry. The industry segment consists of games and computer software developers, hospitals, universities medical training institutions, nuclear medicine clinics and industry.

Stage of Development

TRL 6 – a prototype system demonstrated in a simulated environment and a computer software.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.15392/2319-0612.2023.2276
https://doi.org/10.1016/j.nucengdes.2023.112497
https://doi.org/10.5335/rbca.v14i1.12109
https://doi.org/10.1016/j.anucene.2015.08.017
Software copyright certificate: BR 51 2022 002475-6

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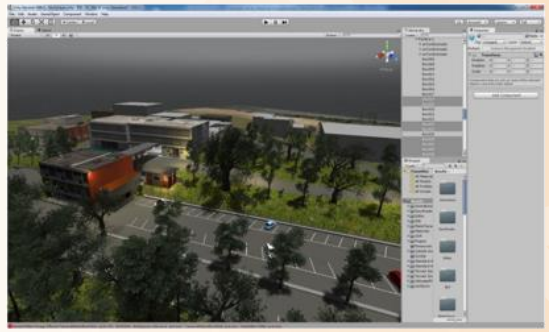

RECOVERY PROCESS OF IRON OXIDE FROM SLUDGE IN IRON ORE CONCENTRATION

Problem

The mining industry still presents environmental pollution issues, which are often caused by leakages of mining tailings. Mining tailings in iron ores are the materials left behind after the economically valuable fraction of iron ores has been extracted. An example is the sludge with silica gangue. Many iron ores may have a low iron content or a high silica content (classified as low-Fe grade ores). In this sense, iron ores must be treated and ground to a fine granulometry to separate the iron oxide from the silica gangue. Existing flotation processes have not been commercially adopted due to poor quality of the iron oxide concentrate, the requirements needed for accurate control of operating conditions, as well as many process steps involved and the high operating costs of reagents.

Solution

An extraction method of iron oxide from the iron ore concentration process, reducing the volume of sludge (waste) and increasing its overall efficiency. An ultrafine iron oxide concentrate is obtained and is incorporated into the pellet feed production in the steel industry. The method consists of draining the sludge to a moisture content of 13%, adding carbonates or alkaline hydroxides, calcining in the air, tempering and then leaching the formed glass matrix in an acidic medium. The method enables the recovery of the sludge with a high added value.

Competitive Chart

The mining industry experiences a moderate growth, with increasing steel production in developing countries (especially Southeast Asia) that will drive demand for iron ore pellets over the next few years. An environmentally friendly technology that has a clear competitive advantage represents a great opportunity. The industry segment comprises concentration machinery and mining-type manufactures, iron ore mining companies and wastewater treatment industry.

Stage of Development

TRL 3 – technology has experimental proof of concept with lab measurements related to the structure and characterization of the material obtained from the extraction method. These tests (scanning electron microscope image, X-ray diffraction and fluorescence) indicate the presence of iron oxide in the hematite phase, in conditions to be added to the production of pellet feed, while the supernatant presents compounds such as malladrite, alkaline silicates in amorphous phase and iron fluorides.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.4236/JMMCE.2017.54013
Pat. number: BR 10 2018 015600-4

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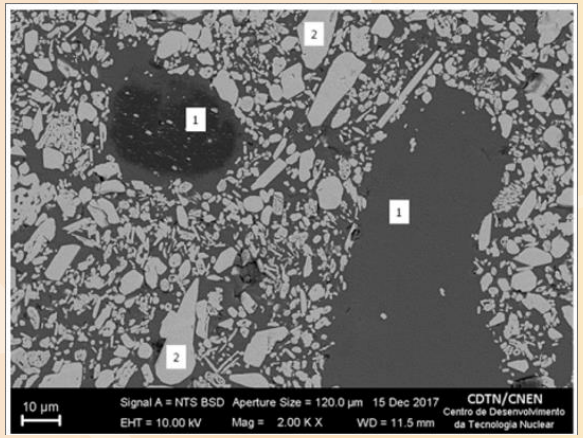

DEGRADATION PROCESS OF AQUEOUS EFFLUENTS WITH ORGANIC CONTAMINANTS VIA MAGNETIC INDUCTION HEATING

Problem

Organic contaminants like antibiotics are chemically active compounds that are discharged in the environment from many industries. It is still a global challenge to treat aqueous effluents contaminated by theses organic compounds. Water treatment demand is imperative due to climate change and water scarcity concerns worldwide.

Solution

A process of the degradation of aqueous effluents contaminated with organic compounds, using heating via magnetic induction and oxide magnetic particles (such as such as hematite, maghemite, magnetite, goethite and ferrites). Several advantages exist when compared to conventional degradation methods: a clean process with good efficiency in the degradation of different types of organic contaminants; low application cost; operation at neutral pH, acidification and neutralization are not required. In addition, the magnetic material can be reused in the effluent treatment process.

Competitive Chart

The wastewater treatment industry is likely to expand at an overall slow to moderate rate over the next several years. There is opportunity for sustainable and energy-efficient water treatments particularly in the context of industrial waste with high concentrations of organic contaminants. There are many companies trying to remove organic contaminants from wastewater by selective filtration methods, but there's no evidence of magnetic induction heating systems being used on a commercial scale. The industry segment is composed by Sewage treatment equipment manufacturers, water treatment and industrial plants providers and water districts. Thus, magnetic induction heating could be an additional step enhancing the treated water quality.

Stage of Development

TRL 3 – technology has experimental proof of concept with lab study and measurements related to the degradation of amoxicillin in the presence of ferrite via magnetic induction using alternating current (AC) magnetic field. The tests conducted were UV-Vis spectrophotometry, high performance liquid chromatography (HPLC) and electrospray ionization mass spectrometry (ESI-MS). The results indicate the amoxicillin reduction from 80% to 90%, varying according to the ferrite concentration and time of exposure to the AC field.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1016/j.ceramint.2020.05.249
Pat. number: BR 10 2019 024119-5

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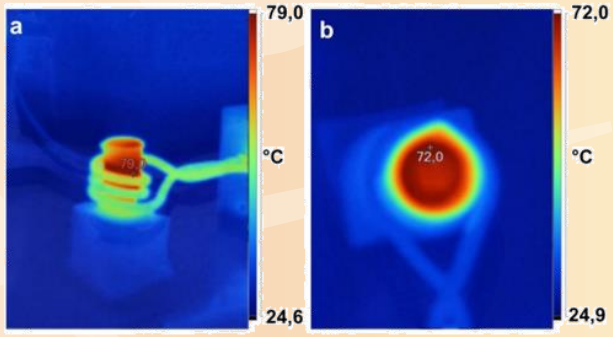

DEVELOPMENT AND APPLICATION OF RADIOACTIVE TRACERS IN INDUSTRY AND THE ENVIRONMENT

Problem

Companies establish procedures and preventive maintenance of their equipment with focus on promoting efficiency and avoiding future problems. Conventional techniques used in the identification of leaks and obstructions and in the measurement of liquid, organic and gaseous fluid flows require direct-contact measuring instruments and the interruption of the industrial activity. These inspection techniques are invasive and may even require the removal of the equipment or device to be inspected from the production line. It can seriously affect the entire production process, causing unpredictable and costly downtime to repair and replace.

Solution

A method of equipment inspection using a radiotracer. A small amount of a short half-life radioactive material (varying from hours to days) through an instantaneous injection and in the most appropriate chemical form to the media reveals leaks or obstructions and measures flow. Detection is done through statistical modelling, using residence time distribution. The advantages of this technique lead to a highly favorable cost-benefit ratio, enable an increase in productivity and an improvement in the final quality of the production process, minimizing operating costs and reducing the frequency of maintenance stops.

Competitive Chart

The markets for leak detection, flow meter and repair, radiation detection, testing, inspection and certification are expected to grow reasonably in the next five years, due to environmental and safety concerns. The industry segment comprises radiation detection and monitoring instruments manufacturers, testing and inspection equipment manufacturers, maintenance service companies, industries (oil and gas, mining, chemical, among others). The technology is at an advanced stage of development and presents great opportunities.

Stage of Development

TRL 7 to 9 – the actual system is already operating in several inspections in natural gas processing plants and in the evaluation of effluent treatment tanks. There is also a partnership with the Brazilian Petroleum Corporation (PETROBRAS) for the synthesis development of an ideal gaseous radioactive tracer for applications in oil and natural gas offshore platforms and a gaseous radioactive tracer injection system for facilities and units that operate at pressures up to 200 bar. In the latter, the system prototype will be demonstrated in an offshore platform.

Achievements to Date

Scientific publications and tests.
Sci. pub.: https://doi.org/10.1016/j.apradiso.2013.12.006
https://doi.org/10.1007/s10967-020-07529-3
https://doi.org/10.2478/nuka-2021-0009
A patent application in partnership with PETROBRAS and ATOMUM referring to the injection system is in progress to be filed.

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THERANOSTIC RADIOPHARMACEUTICAL FOR TREATMENT AND DIAGNOSIS OF CANCERS AND BONE DISEASES AND PROCESS OF OBTAINING THEREOF

Problem

Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths. Mortality can be significantly reduced if cases are detected and treated as earliest as possible. Cancer treatments, such as chemotherapy, radiotherapy or surgical removal of tumor masses, may also fail due to insufficient action specificity or ineffectiveness. New approaches are being investigated based on the molecular characteristics of cancer, provided by genetic changes in tumor DNA, allowing the use of more specific and personalized techniques. Theranostics combines cancer diagnosis and therapy, aiming at early diagnosis, accurate molecular imaging, and precise treatment at the right timing and proper dose, followed by real-time monitoring of treatment efficacy.

Solution

A radiopharmaceutical produced from folic acid (FA) and medronic acid (MDP) and complexation with a biocompatible radioisotope (Cu-64), forming more than one bond with folate-medronate. The dimer FA-MDP-64Cu-MDP-FA is dispersible in water and can be injected in humans to serve as a theranostics agent for various types of cancer, such as breast, lung, kidney, brain, colon and ovary, as well as bone diseases such as osteomyelitis, osteitis, osteosclerosis, osteoporosis, osteomalacia, osteoblastoma, osteoma, osteochondroma, osteolysis, Legg-Calvé-Perthes syndrome, enchondroma, fibrous dysplasia, Kienböck disease and Köhler disease.

Competitive Chart

Nuclear medicine, imaging and radiopharmaceuticals markets indicate a moderate to high growth and present potential opportunity due to the highly innovative dimer type molecule. The market growth is likely being driven by the increased research and interest in nuclear medicine and radiopharmaceuticals. Nuclear medicine preparations and pharmaceutical manufacturers, hospitals and medical research institutions and clinics represent the industry segment. Companies may recognize the clarity of the features and benefits of this innovative molecule.

Stage of Development

TRL 2 to 3 – technology has experimental proof of concept with lab study and measurements related to the molecule characterization by spectroscopy in the UV region and X-ray diffraction, proving that Cu-64 with high radionuclide purity in the radioisotope production process. A preliminary test for colloidal stability also demonstrated a stable behavior of the suspension for 24 hours.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1016/j.matchemphys.2020.123265
Pat. number: BR 10 2020 019102-0

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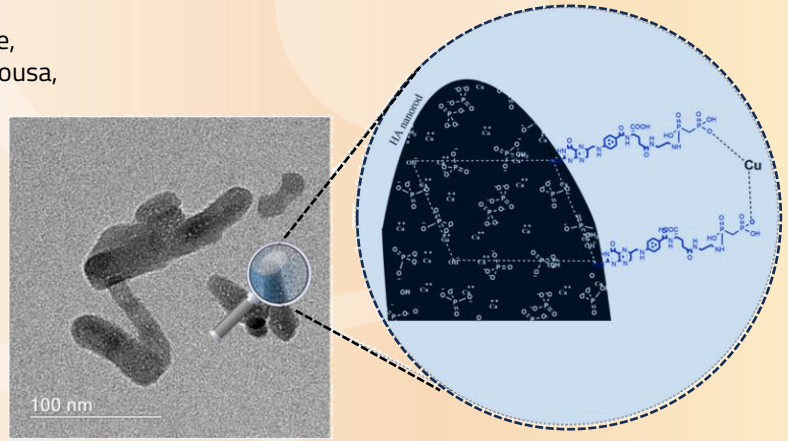

NOVEL NANO DRUG DELIVERY PLATFORM FOR ENCAPSULATING DRUGS

Problem

Many existing and new drugs, while effective, can have significant side effects. Targeted drug delivery systems can achieve the same efficacy with a significant reduction of the drug concentration and side effects (Examples are cancer chemotherapeutics, antifungal drugs, anti-parasitic drugs).

Solution

A drug delivery system with improved drug absorption, allowing for a lower effective dose and consequently reduced side effects. A process and material that involve functionalizing (covalent bonding) boron nitride nanostructures (BNNs) with chitosan biopolymer on the BNN surface, via microwave radiation-assisted reactions.

Competitive Chart

Nanomedicine is a fast-growing market, with many potential therapeutics currently in the development pipeline. Drug applications range from cancer therapies to anemia treatments. These nanotherapeutics are in a variety of delivery forms, such as liposomes, micelles, dendrimer branched structures, hydrogels, and others. The antiparasitic drugs is also a valued market with a steady growth. Nanotechnology based therapies for pharmaceutical and medicine manufacturers, pharmaceutical companies, research institutions, hospitals, government public health programs represent the industry segment.

Stage of Development

TRL 2 to 3 – technology has envisioned applications and experimental proof of concept with lab study and measurements related to the material characterization by X-ray diffraction (XRD), zeta potential and thermogravimetric Analysis (TGA), indicating that the functionalization process and the drug incorporation were successful.

Achievements to Date

Scientific publications, IP and tests.
Related to sci. pub.: https://doi.org/10.1016/j.nanoso.2020.100616
Pat. number: BR 10 2020 019797-5

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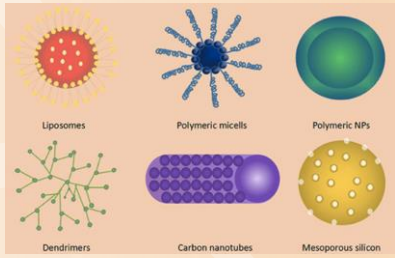

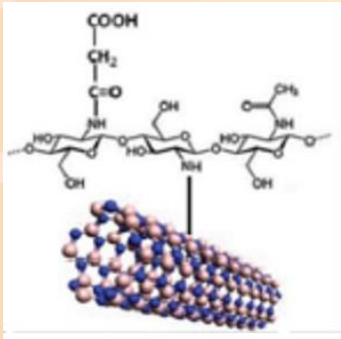

INTERNAL RADIATION DOSIMETRY IRDose

Problem

Cancer is a leading cause of death worldwide, accounting for nearly 10 million deaths. Radiotherapy is one of the cancer treatment alternatives. Peptide receptor radiotherapy is a type of radiation therapy for neuroendocrine tumor patients. It uses the radioactive chemical 177Lu-DOTATATE linked to a peptide (small protein) that targets cancer cells. When this radioactive peptide is injected into the body, it binds to a specific receptor found on some cancer cells. In these targeted radionuclide therapies, it is important to administer an optimal amount of radiopharmaceutical to the patient to ensure the effectiveness of the treatment and reduce toxicity probability for organs at risk.

Solution

IRDose is a user-friendly web application dedicated to an accurate patient-specific dosimetry of 177Lu-DOTATATE treatment using CT and gamma camera images. The website was created using the Django Python-based free and open-source web framework. A Python API (Application Programming Interface) was developed to calculate absorbed dose by way of GATE Monte Carlo simulations and create a dose map (accumulated activity producing the target organ absorbed dose).

Competitive Chart

The market for radiotherapy, radiation oncology, dosimetry, medical image phantoms and medical image analysis software is growing strong with a high number of small companies. Increasing demand for patient specific applications and cost competitiveness may provide opportunities for market entry. The industry segment consists of medical software developers, medical device manufacturers, research institutions, government programs for cancer treatment standardization and safety, hospitals, academic and research institutes, diagnostic laboratories and government health agencies.

Stage of Development

TRL 5 – technology validated with GATE MC code and compared with FDA-approved OLINDA 2.0 using real patient data. The volumes of interest (VOI) were selected from a patient CT image of the liver (left), kidneys (center) and spleen (right) and converted into a 3D mask image. A software as a service (SaaS) prototype was built and is available for testing at https://irdose.ird.gov.br.

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1088/2057-1976/1/4/045201
Software copyright certificate: BR 51 2021 000310-1

Research Team (IRD)

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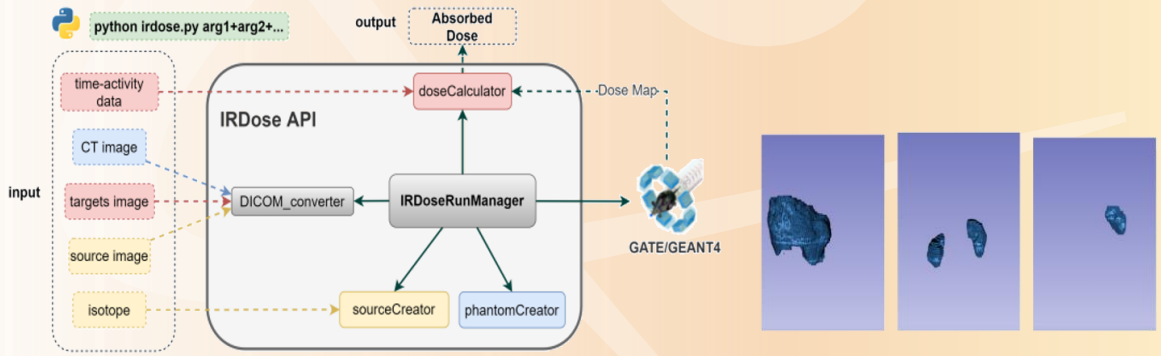

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MOSFET-BASED NON-INVASIVE PEAK POTENTIAL METER FOR X-RAY TUBE

Problem

Patients who often need to have X-ray examinations repeated and poor image quality constitutes a major source of unnecessary radiation for medical diagnosis. Peak kilovoltage (kVp) is an X-ray tube parameter that can influence the radiograph image quality. As well, it can provide an unnecessary radiation dose to the patient if the examination must be repeated. Therefore, monitoring kVp in medical diagnostic X-ray equipment is a recommendation from health organizations.

Solution

A non-invasive measurement method of peak kilovoltage (kVp) in medical diagnostic X-ray beams using two identical radiation sensors of metal-oxide semiconductor field-effect transistors (MOSFETs). This method relies on the buildup cap effect of the device package. Each device when under irradiation provides an intrinsic electrical current due to its own characteristics. In performing a calibration, the kVp potential can be calculated from the signals measured by the devices.

Competitive Chart

Market trends for MOSFETs and radiology as a service are expected to grow due to increasing demand for low-cost, advanced, cloud-based and AI platforms concerning shortage of skilled radiologists globally in a decade. The technology appears to have considerable competitive advantage in its unique use of MOSFETs for kVp measurement. The industry segment comprises X-ray apparatus and tubes (for control, industrial, medical, research) manufacturers, X-ray diagnostic device manufacturers, medical clinics and hospitals.

Stage of Development

TRL 5 – technology was validated in laboratory and demonstrated to an interested company from Recife (NORTRON)

Achievements to Date

Scientific publications, IP and tests.
Sci. pub.: https://doi.org/10.1109/OJIM.2022.3196725
Pat. number: BR 10 2023 006528-7

Research Team and Experience

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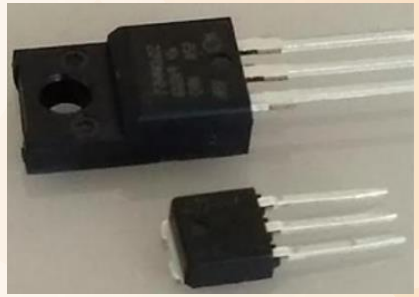

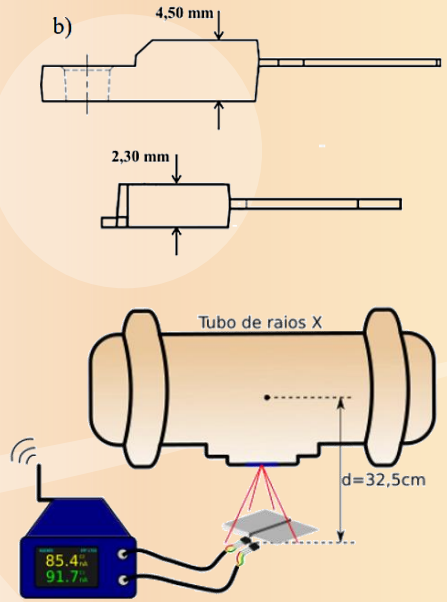

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