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Temitope E Bakare et al., Nano Res Appl 2019, Volume 5
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Dedoped polyaniline/ammonium cobalt phosphate (ACP) hybrid supercapacitor

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Supercapacitor devices are of keen interest because of their high energy density and quick charging and discharging potential among other energy storage systems. Of the materials used in this storage system, polyaniline is known for its monotical charge delivery over discharging potential window. In this work, dedoped polyaniline (dPANI) was modified with 30%, 32%, 34% and 40% ammonium cobalt phosphate (ACP) denoted as dPANI-ACP for improved capacitance performance in 1 M KOH. Results from FTIR studies shows that there is bond between nitrogen of dPANI and cobalt in ACP as confirmed by reduction in intensity of vibration frequency of C–N bond of dPANI-ACP compared to unmodified PANI as well as shift in vibration band of O–P–Ostr to high frequency which is seen as an overlap and a doublet at 806–810 cm-1 on the composites. SEM images, HR-TEM and SAED images show the dPANI as an amorphous strand with good porosity, the ACP as stacked flat crystalline sheets and the dPANI-ACPs as ACP embedded in the PANI strands. This is corroborated by the SAED images in which a regular electron pattern from the ACP crystal is embedded on the characteristic amorphous ring of the dPANI. Specific capacitance (C¬sp) (Fig 1) of the dPANI and dPANI-ACPs from cyclic voltammetry indicated the value of 0.24 Fg-1 for dPANI and 3.61, 0.58, 9.13, 3.67 Fg-1 for 30%, 32%, 36%, 40% dPANI-ACP respectively at 10 mV/s scan rate. Impedance studies corroborated the C¬sp values as the highest phase angle value of 73.6 (90 for ideal capacitor) was obtained for the 32% dPANI-ACP. In conclusion, a modified form of dPANI with good capacitance and ion exchange potential in 1 M KOH has been produced. Further studies like cycling stability and charging-discharging profile of the material is on-going.

Biography

Temitope E Bakare is a Lecturer at Caleb University, Lagos. He holds a Master's degree in Inorganic Chemistry from University of Ibadan, Nigeria. He is a winner of Caleb University capacity development fund and a member of research team awarded a grant by Lagos State Research and Development Council (LRDC) on Environmental Quality Improvements Incident upon Lagos State Urbanization Programme - Projecting outcome of Urbanization Regeneration. He has co-authored three papers. He is currently a PhD student at the University of Kwazulu-Natal, South Africa under the supervision of Professor Werner E van Zyl, Chair of the Sustainable Water, Energy and Biomass (SUSWEB) group at the School of Chemistry and Physics, University of Kwazulu-Natal, South Africa.

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Few layered tungsten disulfide/carbon nanotubes polymer based nanocomposites-synthesis and thermal behaviour

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Plastics, despite thier many advantages, are well known for thier flammability, generation of large amount of toxic gases and hazardous substances. Due to the growing use of these materials in everyday life and incrasing environmental requirements, the flammability of these materials is a topic that has recently become more and more popular. The aim is to make the polymers emit less and less heat during combustion while increasing the temperature of their ignition. Tungsten disulfide (WS_2) belongs to the family of transition metal dichalcogenides (TMDs) whose properties are comperable of those of graphene. WS2 monolayer exhibit very intresting properties, such as high in-plane carrier mobility and electrostatic modulation of conductance and very good thermal propeties. In this work we prove, that few-layer WS2 improve thermal proporties and reduce flammability of polymers. These effects were furher enhanced by the growth of carbon nanotubes on exfolieted WS2 functionalized with nickel and iron oxides. Flame retardant properties were investigated by thermogravimetric analysis (TGA), microcalorimetry and laser flash analysis. Comparing the obtained values of heat released during combustion, it can be observed that the addition of fillers reduces flammability compared to the neat polymers. It is revealed that these composites can provide a certain physical barrier and inhibit the diffusion of heat and gaseous products during combustion.

Biography

K Maslana is a first-year PhD student. During her Master's thesis she explored thermal behavior of 2D materials in commercial polymers. The results of her Master thesis are published partially in K Wenelska, K Maslana, E Mijowska, Study on the flammability, thermal stability and di usivity of polyethylene nanocomposites containing few layered tungsten disulfide (WS2) functionalized with metal oxides, RSC Advances, 2018. She continues her research interest in the field of fire retardant properties of molecular hybrids.

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The development of coaxial electrospun polycaprolactone/silk fibroin based nanofiber for antibody immobilization

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In the present study, uniform coaxial electrospun polycaprolactone/silk fibroin nanofiber was prepared through adjusting the processing parameters and shown to be a viable substrate for antibody immobilization. Using a coaxial tube spinneret with two different solutions, which are pumped to the inner tube and outer tube, electrospun fibers with core-shell structures can be fabricated. Solutions of polycaprolactone (15%) and polycaprolactone (10%)/silk fibroin (10%) blend were individually delivered to the inner and outer channel of a coaxial-tube spinneret for electrospinning to prepare core-shell fibers. The efficiciency of antibody immobilization on nanofiber was tested by in point of care testing. Coaxial electrospun polycaprolactone/silk fibroin nanofibers showed superior antibody attachment, compared to polycaprolactone based nanofiber, due to relatively higher hydrophilicity. This study of incorporation silk fibroin with polycaprolactone has merit of preserving the excellent biocompatibility of silk, and the fibrous three-dimensional polycaprolactone/silk fibroin nanofiber can present enhanced antibody immobilization potential than polycaprolactone alone. Thus this method might open a new pathway to preparing various functional nanofibers with enhanced bioactivity for point of care testing material.

Biography

Tuğba Akbay has completed her PhD at Marmara University and Postdoctoral studies at Virginia Polytechnic University, Moleculalar Biology Department. She has a patented product for the removal of harmful substances from breast milk. She has published more than 30 papers in reputed journals and has been serving as an editorial board member of Turkiye Klinikleri Journal of Dental Sciences cases.

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Electronic water can reduce oxidative stress in cancer and diabetes patients for 3 weeks drinking

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Oxidative stress means a state of imbalance between the oxidizing action and the reducing action due to reactive oxygen species (ROS) in a living body, resulting in the oxidizing action becoming dominant. Oxidative stress arises as the balance between production and removal is disrupted through excessive production of ROS and impairment of the antioxidant system. Oxidative stress has been reported to be involved in the onset and progress of various diseases. Characteristics of type 2 diabetes are insulin secretion failure and insulin resistance, but it seems that oxidative stress is greatly involved in insulin secretion failure. In the insulin secretion-inducing β cells of Langerhans islets in the pancreas, the amount of superoxide dismutase (SOD), which is representative of the ROS elimination system, is small and resistance to oxidative stress is considered to be weak. Regarding cancer, it is well known that chronic inflammatory conditions increase the risk of carcinogenesis. Cells such as neutrophils and macrophages are activated in the inflammation area leading to an increase in the production of active oxygen and nitric oxide. These free radicals cause DNA mutation and cell proliferation thereby promoting cancer development. When chronic inflammation is present, cancer develops more easily. Electronic water, which was developed to generate electron in water, was consumed for three weeks, after meals, between meals and before sleeping 6 times a day, and according to the test subjects' possible time periods. The amount of drinking water was 750-1000 mL, and biological antioxidant potential (BAP) and reactive oxygen metabolites derivative compounds (d-ROMs) checks for all cases were carried out at 4:30 pm. The results of cancer patients and diabetes patients were seen as attached. As a result, the d-ROMs value in the degree of oxidative stress has reduced, and the BAP value, which is an indicator of plasma antioxidant capacity, has improved significantly.

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Numerical simulation for thermal regulation of photovoltaic thermal systems using MWCNT nanofluids

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Photovoltaic applications are the means that converts solar light into electricity. However, the photovoltaic panels' efficiency is highly affected by heat storage and surrounding heat leading to decrease in their efficiency. To solve this problem researchers led to propose a new hybrid photovoltaic thermal system PV/T that generate electricity parallel to absorbing heat for other applications. Entering into the era of nanotechnologies it encouraged more researchers to utilise these technologies in PV/T system using suspension of nano particles in the base fluid called nanofluids. This paper presents a numerical simulation for thermal regulation of PV/T systems using ANSYS Fluent software for multi wall carbon nanotube (MWCNT—water based) nanofluids. The results were validated with experimental results using nano particles volume concentrations ranging from (0-0.3%) at nanofluid flow rate of 1.2l/min. Photovoltaic panel temperature decreased by 11°C at peak solar radiation using 0.075% MWCNT concentration. The system efficiency based on the numerical simulation achieved an overall value of 60.1% over the test period. A very good agreement between the numerical and experimental results was also achieved.

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Selective ablation of nanolayer Ti based thin films by single pulse femtosecond laser

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Laser processing of materials is unique method which allows their morphological as well as composition modifications. In case of usage of ultra-short laser pulses (pulse duration less than picosecond) the laser processing is extremely precise. Irradiation of materials by femtosecond laser enables removal or alteration of their surface at nano/micro level without change of non-irradiated area. Nano scale multilayer thin films are attractive composite materials due to their properties that cannot be obtained in the case of materials of the same bulk constituents. Selective ablation of the upper layer of the nanolayer thin film with little or without damage of the layer or the substrate beneath is significant for applications. The effects of ultra-short laser pulses on reactive titanium-aluminium (Ti/Al) and nickel-titanium (Ni/Ti) nano-layer thin films (NLTF) were investigated. The samples composed of five bilayers (Ti/Al and Ni/Ti respectively) were prepared by ion sputtering on a Si substrate. Single pulse irradiations were done in air by focusing and with linearly polarized gaussian laser beam of 515 nm wavelength, 200 fs pulse duration and variable pulse energy. One step selective ablation of upper layer from NLTFs at low laser pulse energies (Figure 1 and 2) and complete ablation of the thin films from the Si substrate at higher pulse energies were registered. Effects of laser induced morphological and composition changes were monitored by scanning electron microscopy/energy dispersive x-ray spectroscopy (SEM & EDS) and profilometry. Spalative ablation could be the main mechanism that caused ablation of the upper layers from the nanolayer thin films.

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Are solitary waves in microtubules signals for motor proteins?

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Microtubules (MTs) are the major part of cytoskeleton. They are long polymeric structures existing in eukaryotic cells. MTs are hollow cylinders that spread between a nucleus and cell membrane. They are involved in nucleic and cell divisions and organization of intracellular structure. The most important for this work is the fact that MTs also serve as a network for motor proteins. There are two distinct families of MT associated motor proteins that move along MTs carrying molecular and vesicular cargos. These cellular motors with dimensions of less than 100 nm convert chemical energy into useful work. Contrary to ordinary MTs, those existing in neuronal cells are uniquely stable and consequently, neurons once formed don't divide. This stability is crucial as there are evidences that neuronal MTs are responsible for processing, storage and transduction of biological information in a brain. Like all biological systems, MTs are nonlinear in their nature. Investigation of nonlinear dynamics of MTs has yielded to solitary waves moving along MTs. A recently established general model of MTs is explained. It is shown that there are three types of these solitary waves. They are: kink solitons, bell-type solitons and localized modulated waves called breathers. Two mathematical procedures for solving a crucial nonlinear differential equation are explained. They are based on semi-discrete and continuum approximations. It is interesting that the kind of the obtained soliton depends not only on the physical system but also on the used mathematical method as well. It is argued that these waves could be signals for the motor proteins to start and/or to stop moving along MT.

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Porous thin film formed by electrochemical method to improve the corrosion and tribocorrosion performances of Ti-10 Zr alloy in biological solution

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Several surface engineering methods have been explored to enhance the corrosion and wear resistance or tribocorrosion of the titanium and its alloys while maintaining their biocompatibility. Among these methods, the production of oxide films by anodic oxidation treatment offers some promising features. In this research work the electrochemical methods were applied to form a thin porous mixed oxide film (TiO2-ZrO2) on Ti-10 Zr alloy surface. Comparative investigation of untreated Ti-10 Zr alloy surface and porous anodic oxide film growth on Ti-10Zr was carried out to determine the tribocorrosion performances in biological solution were performed. The in situ electrochemical technique is used for investigation of tribo electrochemical degradation and the open circuit potential (OCP) measurement was performed before, during and after sliding tests. The results show that controlled anodic oxidation techniques applied to titanium alloy can significantly enhance the tribo-electrochemical performances of Ti–10 Zr alloy surface for biomedical applications. The tribocorrosion process has applications in orthopedic and dentistry fields, since it is known that the implants are often exposed to simultaneous chemical/electrochemical and mechanical stresses. The formed porous oxide film was tested in biolological solution without and under different imposed loads (tribocorrosion system) and the results were compared with that of the untreated alloy surface.

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Bioinspired micro and nanostructured surfaces with controllable dynamic wettability

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Biological surfaces create the enigmatical reality to be contributed to learning of human beings. Such biological surfaces with multi-gradient micro and nanostructures (MN) display unique wetting functions in nature, which have inspired researchers to design originality of materials for promising future. In nature, a combination of multiple gradients in a periodic spindle-knot structure take on surface of spider silk after wet-rebuilding process in mist. This structure drives tiny water droplets directionally toward the spindle-knots for highly efficient water collection. Inspired by the roles of gradient MNs in the water collecting ability of spider silk, a series of functional fibers with unique wettability has been designed by various improved techniques such as dip-coating, fluid-coating, tilt-angle coating, electrospun and self-assembly to combine the Rayleigh instability theory. The geometrically engineered thin fibers display a strong water capturing ability than previously thought. The bead-on-string heterostructured fibers are capable of intelligently responding to environmental changes in humidity. Also, a long-range gradient step spindle knotted fiber can be driven droplet directionally in a long range. An electrospun fiber at micro-level can be fabricated by the self-assembly wet-rebuilt process, thus the fiber displays strong hanging-droplet ability. The temperature or photo or roughness responsive fibers can achieve a controlling on droplet driving in directions, which contribute to water collection in efficiency. Besides, inspired by gradient effects on butterfly wing and lotus leaves, the surfaces with ratchet MN, flexible lotus-like MN are fabricated successfully by improved methods, which demonstrate that the gradient MN effect rises up distinctly by anti-icing, ice-phobic and de-ice abilities. These multifunctional materials can be designed and fabricated for promising applications such as water-collecting, anti-icing, anti-frosting, or anti-fogging properties for practical applications in aerospace, industry and so on.

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Nanocomposite for soils remediation based on iron nanoparticles with biopolymer on bentonite

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Zero-valent iron nanoparticles and nanocomposites based on them are being increasingly used in the purification of various media such as sewage water and soils from persistent organic pollutants (POPs). The main cause for the limited use of these materials is the toxicity of iron nanoparticles with respect to soil microorganisms. The design of a material (composite) exhibiting reactivity in pesticide degradation and simultaneously having a positive influence on the soil microflora is a problem of current concern. We propose a nanocomposite based on bentonite of grade (ERBSLÖH, PORE-Technology) exposed to a biopolymer and iron nanoparticles precipitated during the reduction of simple iron salts. The resulting nanoparticles were characterized by X-ray powder diffraction (XRD) analysis, scanning electron microscopy (SEM), and FTIR spectroscopy. XRD analysis of the iron nanoparticles and nanocomposite powder was conducted on a Panalytical Empyrean X-ray diffractometer (−2 , CuK 1+ 2 radiation, =1.54184 Å). The XRD pattern of Fe nanoparticles with the diffraction peak at 2θ=44.8° was recorded. The avarage particle size, which was calculated by the Debye–Scherrer formula was 4 nm. The observed diffraction peaks at 2 =35.81 , 41.2 4 , 44.81 , 46.05 , 54.80 and 63.04° were attributed to both bentonite and iron nanoparticles. The ecotoxicity of the nanocomposite was studied on microorganisms *Alternaria sp*., 4D and P.viride. The results confirm that Fe(0) nanoparticles can act as both stimulators and inhibitors of growth of micellar fungi. The stimulating effect of Fe(0) nanoparticles was observed in three of the five strains of micromycetes namely 1LD, 5D and 8D. The growth of strains *Alternaria sp*., 4D and P.viride was significantly maintained in the presence of the nanocomposite (AI of 26.88% and 13.91% respectively). At the same time Fe(0) nanoparticles in common with magnetite Fe3O4 nanoparticles have a stimulating effect on the formation and maturation of spores in micromycetes. Thus, the proposed nanocomposite provides a decrease in the toxic effect on the soil micro society while maintaining the ability to degrade some POPs, such as DDT, DDD, and DDE.

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