Antioxidant Capacity and Components of Virginia Grapes

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Abstract:

Grapes are believed to possess health benefits due to their antioxidant (AOX) activity, which has led researchers to explore their effectiveness in the prevention of chronic diseases. We evaluated the AOX properties of two grape varieties (Norton and Cabernet Franc) from four different locations within the state of Virginia. A variety of assays were employed to determine the AOX activity of the samples, such as oxygen radical absorbance capacity (ORAC), DPPH, total phenolic content, anthocyanin content and flavonoid content. Our study indicated that a difference was reported between the two varieties in each test, showing Norton to be the most potent, but varied in regards to its location. However, the only difference that was reported to be statistically significant was total phenolic content. In conclusion, our studies identified the two grape varieties to possess similar AOX activities, varying only in their phenolic content, in which location and variety could have played a factor.

Synthesis and Characterization of Polysulfobetaines

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Abstract

n-Butyl acrylate was copolymerized with two zwitterionic sulfobetaine monomers using dimethyl sulfoxide as the solvent. The copolymers were synthesized in a series in order to determine the effect of zwitterion content on thermal and mechanical properties. An increase in storage modulus and glass transition temperature was observed as zwitterionic content was increased, along with a broadening of the rubbery plateau. Tensile testing showed that as zwitterionic content was increased, the elongation properties of the polymer decrease. The zwitterionic copolymers were also able to be successfully electrospun for the first time, forming nano-size fibers. These properties can lead to these polyzwitterions being used for electromechanical transducers or high energy batteries. The variation between the functional groups of an ester and an amide attached to the vinyl group of each zwitterionic monomer had no significant impact on the aggregation of these copolymers.

Purification of Trimetallic Nitride Template Endohedral Metallofullerenes by Chemical Reaction of Eutectic 9-methylanthracene with Fullerenes

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Abstract

The availability of pure sample is a major hurdle in the study of trimetallic nitride metallofullerenes (TMFs). Current methods of purification are costly, non-recyclable, and take days to be effective. Reported herein is a reversible, solvent-free reaction of melted 9-methylanthracene and soot extract that affords almost complete conversion of empty-cage fullerenes to 9-methylanthracene adducts, while leaving TMFs unreacted. The 9-methylanthracene/ fullerene adducts elute just after dead-time on a PYE HPLC column and have significantly altered solubility. Due to the large differences in retention time of adducts and TMFs, separation of the adducts from TMFs should be a simple matter. In this paper we explored the use of solid-liquid extraction and found that it is not possible to remove all adducts, due to the nature of solid-liquid extraction, but that an ~3-fold enrichment of the percentage of TMFs was observed in both the Sc- and Lu-based soot extracts. A three-fold increase in the concentration of TMFs is enough to significantly decrease the number of HPLC injections required. However, the literature indicates that better separation of TMFs from 9-methylanthracene/fullerene derivatives could be obtained using flash chromatography.

Biodegradable Polymer Nanospheres

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ABSTRACT

Poly(D,L-lactide) stabilized magnetite is a biodegradable, biodispersable complex that can be further synthesized into nanospheres. Subsequently, these nanospheres can be used for biomedical applications such as targeted drug delivery and biospecific cell separation. N-(2-hydroxyethyl)maleimide initiator was synthesized via a three-step process to initiate poly(D,L-lactide) homopolymer, poly(ethylene oxide) homopolymer, and a poly(ethylene oxide)-poly(D,L-lactide) diblock copolymer. The poly(D,L-lactide) homopolymer was used via a nanoprecipitation into dioxane to form uniform nanospheres, while poly(ethylene oxide)-poly(D,L-lactide) diblock copolymer of various concentrations was nanoprecipitated into dioxane non-solvent to produce nanospheres, which were characterized by way of Scanning Electron Microscopy.

Chelidamic Acid: a Key Component of Cryptand Hosts for Self-Assembly of Supramolecular Polymers

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Abstract

Traditional covalently-bound polymers must have a length of n > 100 to be considered useful. Supramolecular self-assembled polymers formed through the host-guest association of cryptands and paraquats have the benefits of reversibility and selectivity, which makes them prospective alternatives to traditional polymers. A strong association constant is required in order to make sufficiently long supramolecular polymers. One calculation suggests that $K_a = 10^6\ M^{-1}$ would yield a polymer of length n = 2000. Cryptand **4**, with branch **5a**, demonstrated $K_a = 5 \cdot 10^6\ M^{-1}$, but has no functional group by which to attach another cryptand. A quantity of 92 g of chelidamic acid (**5b**) was produced in order to synthesize the analogous cryptand. Its structure was confirmed by ^{1}H-NMR, ^{13}C-NMR, MS, and IR spectra. Methods were proposed for the synthesis of **5c** and **5d**, but have not yet been confirmed.

Fabrication and Evaluation of Gas Diffusion Media with Low In-Plane Resistance

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Abstract

Low in-plane resistance gas diffusion layer (GDL) materials are essential to the future of ribbon fuel cells. Building on previous research, this paper describes materials and processes for the manufacture of low in-plane GDLs, as well as polarization performance for a ribbon fuel cell using newly developed GDL. The newly developed GDL carbon cloth uses high conductivity mesophase pitch based on carbon fibers in the weft directions (current carrying direction), and PAN based carbon fibers in the warp direction to improve the strength and durability of the carbon cloth. The in-plane resistance, through-plane resistance, gas permeability and fuel cell performance of the newly developed GDL, as well as tow commercially available PAN based GDL materials, was studied. The generation 3 pitch material exhibited a reduction in in-plane resistance of 95% when compared to the PAN based ELAT, and a 61% reduction when compared to the 2nd generation pitch material. In addition, the 3rd generation pitch material yielded a 50% increase in current density at 0.5V when compared to the best results reported previously for the 2nd generation pitch material.

Impact of Carbon-Nanostructured Anodes on *Escherichia coli* Biofilm Formation and Viability for use in Microbial Fuel Cells

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Abstract

Microbial fuel cells (MiFCs) have numerous applications, one of which is the potential to lower the cost of treating wastewater. In this study, flame-synthesized carbon nanostructures (CNSs) grown on stainless steel mesh were tested for potential use as a novel MiFC anode. The toxicity of this new anode material to *Escherichia coli* K12 was evaluated by monitoring the specific oxygen uptake rates (sOURs) of log-phase cultures: cultures exposed to the CNS-enhanced anodes for 0-4 hours were compared against unexposed controls. Additionally, the ability of *E. coli* K12 to form a biofilm on the novel CNS-enhanced anodes was studied using scanning electron microscopy (SEM). Biofilm viability was studied using fluorescence microscopy with SYTO 9 and propidium iodide (live/dead stain). The toxicity experiment was completed in duplicate. Results indicate that the CNS-enhanced anodes were not inhibitory to the bacteria under aerobic conditions. Across the log-phase, *E. coli* K12 sOURs in the presence of the anodes were at or above the control sOURs. For biofilm formation, cells were given one day to aerobically attach to the anode surface, after which time the anodes were maintained under strict anaerobic conditions for 6-7 days. Imaging with a field-emission, environmental SEM gave clear evidence of *E. coli* present on the surface of the CNS-enhanced mesh. These results indicate that a biofilm can be formed on CNS-enhanced meshes if inoculated aerobically and then maintained in an anaerobic environment. Fluorescence microscopy with live/dead staining was also preformed on the *E. coli* cells attached to the CNS-enhanced anode to study biofilm viability. However, this technique produced highly variable results and was not a reliable means of characterizing biofilm viability.

The Esterification of Carboxymethyl Cellulose and Its Applications as a Drug Delivery Vehicle

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Abstract:

In this paper, the process of esterifying carboxymethyl cellulose (CMC) for use as a drug delivery vehicle is explored. Various sets of techniques are evaluated as possible routes for the esterification process. CMC starting materials of various degrees of substitution and molecular weights are esterified using several different anhydrides. The products are analyzed using several analytical techniques to show the successfulness of the esterification process. Recommendations are then given as to how research should proceed to accomplish the goal of successful drug delivery.

Synthesis and Characterization of Phosphonium Ionenes

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Abstract:

The ability to synthesize ionenes that have high molecular weight, thermal stability and cationic charge, is highly desirable for a number of applications. A series of phosphonium ionenes were synthesized using various bis(diphenyl)phosphines and dibromides containing different length alkyl spacers. Molecular weight was determined by size exclusion chromatography (SEC) and ^{1}H NMR. Reaction conditions were varied in order to find their relationship to the molecular weight obtained. It was found that solvent, concentration and excess dibromide did not have control over the molecular weight whereas charge density was inversely related to the molecular weight. The phosphine, when in solution, was found to be susceptible to oxidation and may be a cause of low molecular weight ionenes being formed. In order to counteract this problem, a diol (1,4-Bis[(hydroxyethyl)diphenylphosphino]butane Bromine) was synthesized. The diol allows the cationic charge to be formed in the monomer rather than the polymer and therefore allowing it to be stabilized and purified easier. This monomer can now be incorporated into a number of polymers.

Enhancing the Conduction Layer Performance for the Cathode and Anode of Micro-tubular Fuel Cells for Micro Air Vehicles

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Abstract:

A micro-tubular fuel cell has been developed after the conventional planar fuel cell. This new tubular geometry promises a higher power density and the elimination of the space occupied by the conduction plate's manifold in the planar fuel cell. The micro-tubular fuel cells used by the authors, lack the presence of an electron conduction layer across the cathode and the anode. In the approach to boost the power density output, new methods for electron conduction have been developed.

Synthesis and Characterization of Ion-containing, Hydrocarbon-based Multiblock Copolymers as Novel Proton Exchange Membranes

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Abstract

An integral part of fuel cells is the proton exchange membrane. Our group has focused on the synthesis of various poly(arylene ether sulfone) systems in the past few years to understand the effect of chemical composition on fuel cell performance. The aim of this research was to synthesize hydrophobic-hydrophilic poly(arylene ether-disulfonated arylene ether sulfone) BPS-BPSH segmented copolymers as novel proton exchange membranes. The influence of varying BPS-BPSH sequence lengths on transport and mechanical properties was then investigated. These multiblock copolymers were synthesized *via* nucleophilic aromatic substitution step growth polymerization by coupling hydrophobic and hydrophilic *telechelic* oligomers with different molecular weights. BPS oligomers were end-capped with highly reactive decafluorobiphenyl to allow for coupling under mild reaction conditions (110 °C) while preventing side reactions such as ether-ether interchange. Proton conductivity, water uptake, swelling ratio, ion exchange capacity, and the self-diffusion coefficient of water increased while the intrinsic viscosity and proton transport activation energy decreased at longer block lengths with higher hydrophilic fraction sequences. These ionic block copolymers with nanophase separated morphology surpassed the performance of a partially disulfonated BPSH-35 statistical copolymer. Under partially hydrated conditions, BPS-BPSH multiblock copolymers exhibited high proton conductivity, one of which behaved superior to Nafion.

Air/Water Interface Study of Poly(ethylene glycol) Monostearate Esters and Magnetic Nanoparticles Stabilized with PEG Surfactants

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Abstract

Natural, saturated fatty acids have a long history as microbicides against many pathogens. In order for microbicides to be effective, there needs to be a method of releasing the drug into the body that will target the pathogen. The integration of nanotechnology products, such as nanoparticles with therapeutic agents, is a growing area of medical research. The focus of this research is to measure the surface pressure-area isotherms of poly(ethylene glycol) (PEG) monostearates. It was found that the isotherms produced by the PEG monostearates showed molar mass dependent behavior. There was a general downward trend in collapse pressure as the chain length of the PEG linker increased. These surfactants also serve as starting materials for synthesizing conjugated fatty acids with variable PEG lengths. Once these molecules have been made they will be used to replace oleic acid on magnetic nanoparticles (MNPs) synthesized with an oleic acid stabilizing layer. Oleic acid stabilized MNPs were successfully synthesized.

Stress Relaxation Fixture, A Method For Testing Thin Film Specimens

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Abstract:

In many engineering applications one is required to determine material properties of thin films or membranes. DMA is used to collect stress relaxation data for films or specimens with thicknesses on the order of micrometers. DMA can only test one specimen at a time and are generally in high demand for a variety of research. Consequently, it is not an efficient use of these machines to run long-term tests on specimen in order to obtain stress relaxation data. As well DMA is not designed with immersion capability as a primary function. A need for a long term test fixture with immersion capability resulted in the design of a load frame for running long-term stress relaxation and immersion tests on thin films commonly referred to as the stress relaxation fixture, or SRF. This article will discuss the design, test procedure and a comparison of the SRF and DMA. As well as data analysis for stress relaxation and some sample results for Gore 57 PEM.

Evaluating the time and temperature dependent biaxial strength of Gore® 57 using a pressure loaded blister test

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ABSTRACT

Temperature and moisture fluctuations in operating fuel cells impose biaxial stresses in the constrained proton exchange membranes (PEM). The strength of the PEM and its ability to withstand cyclic environment-induced stresses plays an important role in membrane integrity and consequently, fuel cell durability. In this study, a pressure loaded blister test is used to characterize the biaxial strength of Gore® 57 over a range of times and temperatures. Hencky's classical solution for a pressurized blister is used to convert pressure measurements into biaxial strength values. A quasi-elastic approximation is employed to modify Hencky's elastic solution in order to treat the viscoelastic behavior of the proton exchange membrane. Biaxial strength master curves are constructed using traditional time-temperature superposition principle techniques as well as using assumed power law and logarithmic models of the burst strength versus time-to-failure relationship. The different shifting routines are validated through comparison with published temperature shift factors obtained from constitutive tests of the material. Further work characterizing the relative humidity dependence and extension to encompass other commercially available membranes is proposed.

Molecular and Biochemical Analysis of Oxidative Stress in Toxin-Induced Dilated Cardiomyopathy Turkey (*Meleagris gallopavo*)

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Abstract

Dilated cardiomyopathy (DCM) is a disease that affects humans and other animals, including birds, which often results in mortality. Oxidative stress (OS) and mutations in the mitochondrial DNA (mtDNA) are among the factors known to be associated with the incidence and severity of DCM. In this study, we evaluated the relationship between OS and toxin-induced DCM in the turkey, using superoxide dismutase (SOD) and malondialdehyde (MDA) as biomarkers. Further, we searched for nucleotide variation in 2 tranfer (t) RNA genes and evaluated the association with the incidence and severity of DCM. The treatment group was fed a diet containing 700 ppm furazolidone (Fz) to induce DCM while the birds in control were fed a diet without Fz. Blood samples were obtained weekly for 6 weeks (wk) to determine plasma MDA and erythrocyte SOD activity, using standard assays, and for mtDNA analysis by PCR. Echocardiographic measurements were taken weekly of Left Ventricular End Diastolic Diameter (LVEDD) and Left Ventricular End Systolic Diameter (LVESD) from the birds from 2-6 wks-of-age. As expected, birds on Fz-containing diet had significantly higher LVEDDs and LVESDs for wks 2-6. Differences between treatment and control groups in the biomarkers for OS were significant only for MDA at wk 2 of age. Though not significant, the treatment group appeared to have lower SOD activity wks 3-5. Analysis of 1200 base pairs (bp) of the tRNA-Arginine and tRNA-Leucine genes of the turkey mitochondria genome showed no variation. This work provides a foundation to further investigate the role of OS and the mitochondria genome in toxin-induced DCM in the turkey.

Synthesis of Collagen Mimic

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Abstract

The purpose of this research project is to create a hyper-stable mimic of the protein collagen. This is an important research goal because collagen is the most abundant fibrous protein in the body, responsible for providing the scaffolding matrix upon which complex biological structures are supported. The degradation of collagen in the body is responsible for many common chronic diseases such as arthritis, joint degradation, and heart disease. The creation of a successful mimic able to withstand environmental as well as enzymatic degradation has almost unlimited applications through out the bio-medical and materials science fields. A collagen mimic is also desirable because of its tensile strength and elasticity. The collagen mimic created by the Dr. Etzkorn group uses her idea of replacing the amide backbone between glycine and proline with an alkene isostere. Mimic synthesis is made possible due to collagens primary repeating sequence of –Gly-Pro-Hyp-, by replacing an amide bond with an alkene in the tri-peptide monomeric unit polymerization of collagen analogs are possible.

Confined Impingement Jet Mixing to Obtain Controlled Size Distributions of Polymer-Stabilized β-Carotene Nanoparticles

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Abstract

The use of nano-sized particles in biomedical applications is very important for targeted drug delivery. However the minute scale of the system makes it difficult to control the size distribution of the particles. Because of this, a high pressure, high velocity stream is desired to obtain turbulent flow conditions to ensure that each component in the reaction sees the same environment. To that end, we have successfully designed and implemented a Confined Impingement Jet (CIJ) mixer to generate high pressure, high velocity flows into a precisely-machined mixing chamber. The precipitation of β-carotene from tetrahydrofuran (THF) into water in the presence of different amphiphilic block copolymers was studied to determine which system gave better colloidal stability and more controllable size distributions. The effect of flow rate and experimental trial duration on hydrodynamic diameter was examined through Dynamic Light Scattering.

Modification of Carboxymethylcellulose and its Properties Related to Drug Delivery

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Abstract

New research has found polymers, carboxymethylcellulose esters, with great abilities to be used as drug delivery vehicles. These polymers have the ability to swell at a pH of 5 allowing the drug to be release in the small intestine. The drug is also able for zero-order release, which means the drug is release at a constant rate for 24 hours. This holds great value for patients that are required to take medication multiple times a day. However, in the present research only the acidification and esterification processes were experimented with. Three experiments were performed: the performance of two catalyst, triethylamine and sodium acetate, were analyzed, different hold temperatures were investigated, and the activate was tested for a shelf life. Preliminary results show triethylamine was the better catalyst, temperature of the reaction does have an effect on the product, and the activate does have a shelf life.

Synthesis and Solution Properties of Poly(Sodium Styrene Sulfonate-Alt-Sodium-N(4-Sulfophenyl) Maleimide)

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Abstract

Poly(styrene sulfonate-alt-sodium-N(4-sulfophenyl) maleimide) (PSSM) has been synthesized by free radical copolymerization and is thought to have a rigid, rod-like structure. A chain transfer reagent was used to control the molecular weight of the copolymer, but the molecular weight was unable to be determined by SEC. The viscosity behavior of PSSM was compared with the viscosity behavior of poly(sodium styrene sulfonate) (PSS) both with and without added salt. The reduced viscosity of PSSM was found to be much higher than the reduced viscosity of PSS which suggests that PSSM is a rigid, rod-like copolymer. However, without molecular weight data no direct conclusion can be made.

Electrochromic Properties of ISAM device Based on PANI and PASA

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Abstract

In this research, electrochromic properties of an ISAM (Ionicaly Self Assembled Multilayer) device was studied for its contrast in visible spectrum as well as its redox states. The device was based on Polyaniline (emeraldine base), (PANI), and Poly (aniline 2-sulfonic) acid, (PASA), both with known electrochromic properties. Both these polymers were already studied in individual devices, combined with different non-electrochromic polymers. What makes this research significant is the combination of the two polymers, which made the device a multi-electrochromic device with significant properties which are by far more efficient than the devices made by either of the polymers individually. The contrast of the device at 4.6 Volts potential difference range was an average of about 50% with the peak of 51.4% at 590 nm wavelength. This high contrast at such a wide wavelength range 450nm to 700nm makes this device a very good candidate for smart glass that can be used in civil and military applications.

Fatigue Damage of E-Glass/Vinyl-Ester Composites Under Fully Reversed Loading

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ABSTRACT

Dynamic loading and fatigue failure are some of the largest hurdles to understanding how a material functions. While this has been overcome for metals there is little understanding of how these issues affect fiber reinforced polymer composites. There have been many attempts to predict fatigue lifetimes of fiber reinforced polymer composites. Most of the time statistical analysis is used to try to come up with a quantitative model. This method causes these models to be phenomenological. While these models have allowed for use of composites to become more widely available, the lack of understanding of damage mechanisms causes the use of these materials to be inefficient. This inefficiency is caused through not being able to reliably predict when the material will fail. The Materials Response Group has conducted studies that indicate that at different stress levels the damage mechanism that causes failure changes. Knowing what damage mechanisms are causing failure may allow for a more complete model to be formed. Using microscopy these damage mechanisms were examined, looking at fully reversed loading (R=-1) and several percentages of expected lifetime. The results of this study revealed several interesting trends in transverse crack counts and yielded further data still being examined. This showed a linear trend at a target lifetime of 1,000 cycles, crack saturation at a target lifetime of 10,000 cycles, and a jump after apparent saturation at a target lifetime of 100,000. Further work will be an examination of video taken during testing for delamination progression and comparison to edge replication.

The Effect of Graphite Type on Bipolar Plate Composites for Proton Exchange Membrane Fuel Cells

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Abstract:

In this paper, a method to improve the through-plane conductivity n graphite filled laminate structure PPS based polymer composites is described. In previous work by the co-authors, it was reported that PPS based laminate composite bipolar plates made with TC300 platelet graphite particles exhibited relatively high mechanical properties and in-plane electrical conductivity at ambient temperature. However, the through-plane conductivity of the materials needed improvement. In this work, different size and shaped graphite particles were used in an effort to improve the through-plane conductivity. The graphites used were TC-300 platelets (150 μm diam.), Asbury platelets (~75 μm diam.), and spherical (~20 μm diam.). The through-plane conductivity of the laminate composites showed negligible dependency on graphite, indicating other factors may be contributing, such as residual stress, to the poor balance of in-plane and through-plane conductivity. There was also negligible difference between the mechanical properties of the different graphite types.

Formation and sorption of trihalomethanes in chlorinated polyvinyl chloride and polyethylene pipes used in drinking water distribution systems

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ABSTRACT

Polymeric pipes provide an alternative to metal pipes used in residential drinking water distribution systems. This study investigated the leaching of total organic carbon (TOC) in the presence of free chlorine and the potential formation and/or sorption of trichloromethane in pipes including PEX-a, PEX-b and cPVC. Our study involved new commercial piping filled with standard drinking water. The pipes remained statically at rest for 3-4 days while organic carbon leached from the pipes to the water, reacting with free chlorine forming trichloromethane. New pipes were also filled with standard water containing 25 µg/L of trichloromethane to measure sortion capability of this compound during a 3-4 day period. Water was then removed from the pipes to determine the trichloromethane concentration remaining. All three pipes leached a significant amount of TOC into the water ranging from 236 µg/L for cPVC, 249 µg/L for PEX-a to 376 µg/L for PEX-b. This TOC reacted with the disinfectant residual to form trichloromethane. During the first 72 hour flush, the trichloromethane concentrations ranged from 11 µg/L for cPVC, 13 µg/L for PEX-b to 16 µg/L for PEX-a. Because PEX-a and PEX-b leached the largest amount of TOC and PEX-b and cPVC consumed the lower amounts of free chlorine, there was no significant statistical difference among the pipes for formation of trichloromethane. During the sorption phase, PEX-a and PEX-b sorbed 5-10 ug/L trichlormethane while cPVC had no change in concentration. The following report contains more detailed information and data supporting the formation and sorption capabilities of PEX-a, PEX-b and cPVC piping.

Stability Studies of Magnetite Nanoparticles

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Abstract

Magnetite nanoparticles were stabilized using two series of complexes containing 30%, 50%, and 70% polymer weight compositions in order to determine the minimal amount of polymer needed to stabilize the particles. In the first series, a 5,600 g/mol poly(propylene oxide) (PPO)-3,800 g/mol poly(ethylene oxide) (PEO) diblock copolymer was used to stabilize the nanoparticles, and in the second series, a 5,600 g/mol PPO-7,200 g/mol PEO diblock copolymer was used to stabilize the nanoparticles. The complexes were dialyzed in water and phosphate-buffered saline (PBS) solution. Thermogravimetric analysis (TGA) and Dynamic Light Scattering (DLS) were used for bulk composition studies and stability studies throughout the dialization procedure. A model was developed which had some success predicting the sizes of the complexes in various media based on a number of measurable parameters. TGA confirmed that dialysis in water did not affect the bulk composition of the magnetite-polymer complexes. The model accurately predicted the size of the 70% 5,600 g/mol PPO-7,200 g/mol PEO complex both before and after dialysis in water. These complexes also showed the greatest stability in PBS solution.

Synthesis and Characterization of Novel Poly(ethylene glycol) – Glutathione Conjugates for Biomedical Applications

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Abstract

Degenerative diseases and disorders such as cancer, Alzheimer's and Parkinson's diseases have numerous causes and many people are affected by such diseases. Although these disorders can stem from more than oxidative stress related damages, oxidative stress is thought to play a vital role in these disorders and diseases. Reactive oxygen species (ROS) consisting of molecules such as free radicals, peroxides and oxygen ions species, are highly reactive and can be toxic resulting in massive cellular and tissue damage in biological systems. In this work, glutathione is used as the antioxidant which is to protect cell from the deleterious effects of the oxidative stress. The delivery of glutathione must be controlled, of low toxicity and specific; this is to be accomplished with utilizing polymeric drug delivery systems which offers the aforementioned properties, biocompatibility, and moderate transfection efficiency. Employing poly (ethylene glycol), PEG, as the polymer used for delivering the antioxidant. Two conjugated triblocks were synthesized, characterized, and used to challenge in human neuroblastoma, SH-SY5Y cells to measure viability and protection of the cells. A Michael addition reaction was used to synthesize, GSH-PEG-GSH, as a model compound, as hypothesized the Michael triblock proved not effectively protect the cells. The disulfide linked triblock, cleavable sulfide linkages triggered under acidic conditions, GS-SPEGS-SG, challenge was evident of protection against oxidative stress at proper concentration levels.

Oxidation of Algae Oil, Flax Oil, and Milk fat and the Effect of Chitosan and Lipoic Acid

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Abstract:

The plausibility of supplementing healthier, unsaturated fats for milk fat in dairy products was evaluated by gathering data on relative rates of oxidation of different lipid sources. Oxidation of algae oil, flax oil, and milk fat were compared during storage at 40°C for 18 days. Flax oil and algae oil oxidized much more rapidly than milk fat due to their unsaturated fatty acid content. Iron was added to milk fat and flax oil to evaluate its ability to act as a pro-oxidant. The iron had no significant effect on milk fat oxidation, but did cause flax oil to oxidize more rapidly. Chitosan and lipoic acid were added to flax oil to determine the antioxidant potential of each. Chitosan did not exhibit a significant effect, but lipoic acid was extremely effective as an antioxidant in flax oil both with and without the addition of iron.

Quantifying the Dynamics of Thermoelastically Driven Nanoscale Beams in Fluid

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Abstract

One of the current challenges faced by nanoelectromechanical system devices is the efficient actuation and detection of motion in fluid due to the small displacements at high frequencies. The purpose of this paper is to increase the quality factor of a nanoscale beam immersed in a viscous fluid by studying both its physics and geometry. The effect of the fluid on the resonant frequency of oscillation of the beam were studied. An analytical model and numerical results for the beam dynamics are presented. The analytical approach is based upon a simple harmonic oscillator approximation. Using numerical simulations it is demonstrated that the geometry of the beam can be effectively tailored to increase the quality factor. Our results are for nanoscale doubly clamped beams that are thermoelastically driven in water.

Characterization of Swelling Behavior in Thin Films of Biphenyl Poly(Arylene Ether Sulfone) Copolymers

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Abstract

Potassium salt and acid forms of biphenyl poly(arylene ether sulfone) copolymers containing 35 mol% ionizable monomers, BPS-35 and BPSH-35, respectively, are being investigated for use in proton exchange membrance (PEM) fuel cells because of good electrical conductivity. This study investigates the swelling behavior of the polymer in water, methanol, ethanol, isopropanol, and cyclohexane. Changes in thickness were measured using ellipsometry and a quartz crystal microbalance (QCM). It was found that BPSH-35 exhibited higher degrees of swelling relative to BPS-35. Most notably, water swelled 1% and 20%, methanol 27% and 56%, cyclohexane 0.1% and 0.8% in BPS-35 and BPSH-35 respectively. QCM experiments are currently being conducted to confirm these observations.

Well Defined Multifunctional Magnetic Nanoparticles

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Abstract

The synthesis and characterization of multifunctional magnetic nanocarriers are discussed herein. The objective of this paper is to synthesis magnetic complexes comprised of magnetic nanoparticles, i.e., magnetite, hydrophilic polymers, and bioactive molecules. Maleimide initiated poly(ethylene oxide) (PEO) oligomers were functionalized via the free hydroxyl group utilizing phosphorous oxychloride. The synthesized PEO oligomers bearing the phosphate anchor group adsorb onto the surface of magnetite. Further functionalization on the maleimide-rich magnetite-PEO complexes was demonstrated. In this paper, biotin and fluoresceinisothiocyanate (FITC) were coupled to the maleimide ends to yield multifunctional magnetic nanocarriers.

Solvent Effects on the Kinetics of the Hydroxyl Radical Generated from *N*-hydroxypyridine-2(1*H*)-thione

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Abstract:

Laser flash photolysis (LFP) of *N*-hydroxypyridine2-(1*H*)-thione in the presence of *trans*-stilbene in acetonitrile generates a transient absorbance at 392 nm. This signal is attributed to the hydroxyl radical addition on a nanosecond timescale to the *trans*-stilbene, and the dimerization of the pyrithiyl radical on a microsecond timescale. Using a range of substrates, the rate of hydrogen abstraction by hydroxyl radical was monitored using pseudo-first order kinetics. Compared to studies previously conducted in the water and the gas phase, rate constants for hydrogen atom abstraction by hydroxyl radical are slower in the non-aqueous solution, acetonitrile. The rate of hydroxyl radical reactivity was also monitored in 10% H_2O/90% acetonitrile for further analysis. The increased rate in an aqueous solution is attributed to hydrogen bonding between the hydroxyl radical anion and water in the transition state. This assumes that the hydroxyl radical may not be as reactive, as previously thought to be, especially in less polar environments.