## Chemistry (600)

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The Use of the Alternated Soaking Process to Create a Chitin-Goethite Nanocomposite Optimized in Tensile Strength

Soham Dessai

The teeth of limpets, consisting of goethite nanofiber within a softer protein phase, have been proven to be the strongest natural occurring material. A bio-inspired nano-composite was modeled after these teeth in an attempt to achieve a similar tensile strength. The novel alternate soaking process was used to make a chitingoethite nanocomposite that would be optimized in tensile strength. A chitin film was first developed using an existing method and was alternately soaked in goethite and chitin using a crane made from an inexpensive robotics kit. The number of soakings was changed after each trial, starting at 20 soakings and incrementally increasing by 20 soakings. The nano-composites were then tested for tensile strength. They were later viewed under a Scanning Electron Microscope for better understanding and a visual representation of the composite. Data is forthcoming and is expected to be collected by March 2016.


I/We hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year’s research. I/We also attest that the above properly reflects my/our own work (digitally signed).
The Effect and Cost Efficiency of Natural and Chemical Pesticides and Repellants on Formicides (Ants)

Amanda Hakins

This project consisted of a number of experiments to determine which substances provided the most reliable and cost effective solutions for repelling ants. Chemical pesticides, household products, and natural repellants were used in these tests. A simple test setup was constructed allowing the number of ants crossing a boundary treated with each substance to be counted over a predetermined period of time. The fewer ants crossing the boundary, the more effective the substance was at repelling them. If the cost of the substance was low and repelled ants efficiently, then the product would be considered cost efficient. Even though the natural repellants (hot sauce, lemon juice, etc.) were the best at repelling, they were not cost-efficient to use. The chemical pesticides were very cheap to use but did not actually repel the ants in a timely manner, but they did kill the ants off over time. The most cost-efficient product to use was a laundry softener followed by dishwashing liquid. These detergents demonstrated the fewest number of ant crossings, along with a low cost.


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Synthesis of Multifunctional Nanoparticles to Induce Hydrophobicity and Antibacterial Properties on the Surface of Packaging Materials

Seoyoung Kang
Yeojin Min

The objective is to synthesize silica-coated silver multifunctional nanoparticles that can exhibit hydrophobic and antibacterial properties. Using different silane chains to change the degree of hydrophobicity, the goal is to find the most hydrophobic and antibacterial nanoparticle solution. These multifunctional nanoparticles have potential applications in the packaging industry. Materials can be coated with a nanoparticle solution, resulting in a hydrophobic and antibacterial surface that can repel water and kill bacteria. This combination can help to protect the contents inside of packages. To make these nanoparticles, a silver colloid was synthesized then coated with different silane chains: TEGS, VTES, OTES, and ITES. The hydrophobicity was measured by coating a glass slide with a nanoparticles solution, pipetting a drop of water on it, and measuring the contact angle. The antibacterial property was observed by growing E. coli in the presence of nanoparticle-dipped filter paper pieces and measuring the disk of diffusion. Nanoparticles were successfully synthesized. Out of all the coatings, VTES induced the highest contact angle. Data has yet to be collected for the antibacterial test. As of now, no conclusions can be made. Ultimately, the multifunctional nanoparticles will be hydrophobic as well as retain antibacterial properties to increase the consumer satisfaction in the delivery of packages.


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Effect of Bicarbonate Salts on the Growth Rate of P. italicum

Connor Kirk

The Purpose of this experiment was to determine whether or not the addition of NaHCO₃, KHCO₃, or NH₄HCO₃ would have an effect on the growth rate of P. italicum. P. italicum is a fungus that can grow on citrus plants and result in killing most of the crop. To experiment, four dishes of each condition were prepared, Control, NaHCO₃, KHCO₃, NH₄HCO₃. Each bicarbonate salt was prepared by adding 1ml of the solution into the respectively labeled dishes. Once the bicarbonate salt was added, the dishes were inoculated with a reusable loop that was sterilized after each usage on each dish. Once all dishes were inoculated, they were placed in an incubator set to 250 c to allow to grow, and number of colonies recorded on each day. The data could only be calculated for the first two days since on the third day all dishes exhibited lawn growth. However, based on the calculated data there is enough evidence to support that KHCO₃ did have an effect on the initial growth rate of P. italicum.

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Identification of Optimal pH for Luminol Chemiluminescence

Megan Salvatore
Nathan Vigil

The purpose of this experiment is to determine which pH is most effective at optimizing luminol’s chemiluminescence reaction (C8H7N3O2). This glowing blue light emitted by the reaction of luminol and hydroxide ions forming dianions has caused luminol to become a practical tool for investigating crime scenes. Forensic investigators can utilize this information to increase both the effectiveness and validity of luminol in investigations and court cases. A variation in pH is an easily encountered problem when creating luminol and perfection becomes necessary in order to produce the longest duration of usable luminol. This optimal pH was determined through repeated experimentation on the duration in which luminol lasted according to various pH levels. This research is significant because it can help to improve the performance of luminol when used at a crime scene. Through knowing the pH that optimizes the reaction of luminol, forensic investigators can utilize this information to increase the effectiveness of luminol in investigations.


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The Effect on Photocatalytic Efficiency of Changing the Ratio of ZnO and SnO2 in Nanoparticles for the Purification of Water

Surbhi Singh

This research explores methods to increase the photocatalytic efficiency of zinc oxide-doped tin dioxide nanoparticles. Water splitting using a photocatalyst has gained attention for its potential applications to break down environmental pollutants in water. The reaction begins when photons are released from a light source to excite the electrons in the photocatalyst. A major disadvantage of using tin dioxide as a photocatalyst is that it only absorbs ultraviolet rays due to its large band gap (3.6?eV). The photocatalytic process slows down when electrons fall from the conduction band back to the valence band. This recombination is inevitable in photocatalytic systems but can be reduced by adding co-catalysts. Rather than starting the chemical reaction, these co-catalysts accelerate and increase the duration of the reaction. Previous research has shown that zinc oxide doping increases photocatalytic activity of SnO2 nanoparticles by increased charge separation. It is hypothesized that if the molarity of ZnO in ZnO doped SnO2 nanoparticle photocatalysts is increased, the efficiency of the nanoparticles in methylene blue degradation will increase due to the increased charge separation and extended wavelength absorption spectrum. Data of the first batch of ZnO–SnO2 nanoparticles doped at the lowest ZnO concentration has been collected. It has shown a significant increase in photocatalytic efficiency from the control. More nanoparticles will be synthesized with increased amounts of Zinc Oxide to compare photocatalytic efficiency of increased dopants under both ultraviolet and visible light. Two statistical tests, ANOVA and Kruskal-Wallis, will be run to determine significance.


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