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Encapsulation of a Model Compound Delays its Release From a Biobased Polymer

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Biobased polymers have several advantages over petroleum-based polymers such as polystyrene or polyethylene in that they can be less expensive and more environmentally friendly while retaining functional properties such as controlled release of biologically active compounds. The food-contact tray was originally designed with a biobased polymer infused with an anti-microbial agent such as Nisaplin™; however, caffeine was substituted as the model compound in our preliminary investigations. This composite was then extruded with thermoplastic starch for preliminary investigations in constructing a food contact tray. Caffeine was then combined with pectin and then extruded with thermoplastic starch to form a composite suitable for food-contact trays. Pectin is a cell-wall polysaccharide with unique functionality that makes it ideal for controlled release systems using encapsulation. Starch is the main energy storage polysaccharide for several cereal crops. Both starch and pectin can be processed into a thermoplastic material. Caffeine was physically mixed or encapsulated through dissolution and freeze-drying with pectin. UV-VIS spectroscopy (λ = 273 *nm*) was utilized to measure the release of caffeine from the composite submerged in water. A spike standard curve was used to compensate for any UV absorption by the polysaccharide in the region of interest. Encapsulation did delay the release of the caffeine. The release rate was delayed by at least one hour when the model compound was encapsulated before extrusion. The three types of starch were normal, high-amylose, and waxy corn starch with different amounts of amylose and amylopectin. The type of starch did not affect the release profiles in a significant manner.

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Capacitance and HER Characterization of Electrodeposited Nickel Alloy Thin Films

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With the global energy demand growing, there is greater need for production of energy. One of the ways of producing this energy is creation of hydrogen gas to store energy, however, this technique is not yet economically favorable compared to many other energy sources. One reason for this is the current use of platinum in hydrogen production. As a result, we are exploring other less costly metals for use as hydrogen producing catalysts. With the technique of electrodeposition, different nickel alloy thin films were created to characterize their structure, composition, and hydrogen production capabilities. Characterization was completed using atomic force microscopy (AFM) to measure roughness, scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDS) to measure composition, and cyclic voltammetry to measure electrochemical capacitance. Linear sweep voltammetry was used to perform the hydrogen evolution reaction (HER), a reaction that produces hydrogen gas as a product. The use of these characterization techniques and HER measurements could help further understanding of the production of hydrogen and help fuel cells become more economically favorable using these earth-abundant metals.