Some Research Projects (Spring semester 2022)

1) **Title: Swelling capacity of hydrogels with incorporated Sn and Cu nanostructures**

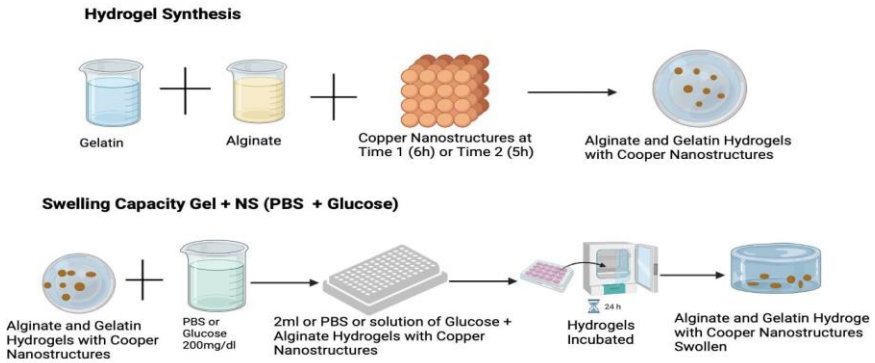
Authors: Lassala Almazan, Krystal[1]; Lassala Almazan, Kenneth[1]; Gonzalez Vega, Isanlerie Naduis[2]; Ortiz Santana, Jorge Luis[2];Torres, Dorcas[2]; Alvarez, Merlis[1]

In recent years, gelatin hydrogels have been of great interest because they have great properties to accelerate the healing process. Approximately 15% of the 30.3 million Americans suffer from chronic injuries. The combination of copper and tin nanostructures stand out for their angiogenic characteristics that accelerate wound healing. These metals are semiconductor materials that under certain circumstances allow the passage of electric current, while if other different circumstances occur, they prevent the transition of electric current and act as an insulator. The combination of nanostructures incorporated within hydrogels containing starch and alginate have great swelling capacity because of their polysaccharide properties. For this reason, we hypothesize that gelatin, alginate and starch based hydrogels with incorporated tin type N and copper type P nanostructures synthesized at different temperatures will have a positive impact on the swelling capacity of gelatin based hydrogels. The hypothesis was partially correct, since the nanostructures synthesized at 600oC helped to increase the swelling capacity while the nanostructures synthesized at 500oC caused the swelling capacity to be null, this is possibly due to the fact that the amount of copper in the samples at 600oC was less than at 500oC and based on the literature, copper inhibits the transglutaminase enzyme, which is responsible for cross-linking the hydrogels to make them stronger (Kieliszek & Misiewicz, 2013). In a future work it would be of good interest to repeat this research, but with tin nanostructures with different amounts of copper.

2) **Title: Study of the Swelling Capacity of Gelatin-based Hydrogels with Cu incorporated for the treatment of Diabetes**

Authors: Angélica I. Figueroa-Bonilla, Joshua O. Marrero-Burgos, Mariela A. Olivencia-Méndez, Luary D. Gómez-Ortiz, Dorcas I.Torres-Padilla, Merlis P. Alvarez-Berrios

A patient with diabetes can take weeks or even months to heal an open wound, as these do not heal as quickly as a person without diabetes. This is because they cannot produce enough cells and molecules that promote healing. Hydrogels are the result of polymer networks capable of absorbing enormous amounts of water or is P-type and is very famous for its simplicity. Copper is one of the materials that has been recognized by the US Environmental Protection Agency (EPA) as an antimicrobial material. The use of this nanomaterial in medical service biological fluids. They, based on gelatin, have gained great interest in recent years because they have attractive properties to accelerate the healing process. However, these have little lasting properties when exposed to the skin. Copper oxide (CuO) is a semiconductor component with a monocyclic structure. This one s is to prevent bacterial infections. Fluorescence is a physical method used to see the different types of bands found in the sample. For this characterization technique, only the emission spectra were used to be able to see the curves. X-rayspectrum dispersive energy (EDX) is used to perform compositional analyses for CuO. Another popular characterization is the use of the optical microscope. This method of characterization allows to observe the microparticles and the color centers of the oxides present in the nanostructures. This research is based on the comparison of the swelling capacity of hydrogels with built-in nanostructures. To assess the swelling capacity, the hydrogels were exposed to the following conditions; an environment that represents a person without diabetes and an environment with glucose that represents a patient with diabetes. Semiconductor nanostructures, specifically copper, were incorporated into these to evaluate the swelling property, duration and effect it has on diabetics. Alginate hydrogels with copper nanostructures has 350% swelling, while Alginate hydrogels with Copper nanostructures in PBS and Glucose reached 800% swelling.

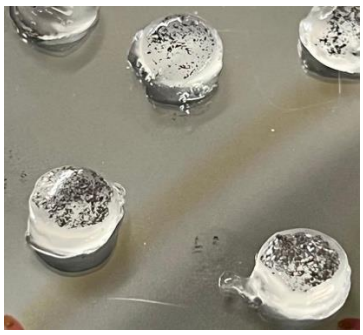


3) **Title:** Evaluación de la tasa de degradación de hidrogeles de gelatina con alginato y nanoestructuras de cobre incorporadas

Authors: Adriana C. Ruiz Silva, Natalia González Rios, Jonathan Méndez Franco**;** Dorcas I. Torres Padilla and Merlis Álvarez Berrios

Los hidrogeles son el resultado de una red de polímeros capaces de absorber distintas sustancias, desde agua hasta fluidos biológicos. Estos hidrogeles pueden ser sintetizados a base de gelatina, proteína biocompatible derivada del colágeno que forma la figura tridimensional en los hidrogeles, y de alginato, polímero aniónico biocompatible compuesto generalmente de una sal soluble de sodio o potasio. Estos compuestos han resultado en el mejoramiento de la capacidad gelificante de los hidrogeles. Mediante otras investigaciones se ha observado que la incorporación de las nanoestructuras a los hidrogeles ha aportado características idóneas para ayudar en el proceso cicatrizante de una herida, ya que estas poseen unas propiedades únicas.

Las nanoestructuras semiconductoras presentan propiedades m. ayores a de dimensiones micrométricas, lo cual es importante para crear nuevos materiales para tratar y diagnosticar diversas enfermedades en la Nanomedicina. Las nanoestructuras crecidas en esta investigación son un óxido de cobre semiconductor tipo P, este tiende a formar dos tipos óxidos, oxido cuproso (Cu2O) y oxido cúprico (CuO). El semiconductor tipo p se le introduce una impureza de tres electrones de valencia como dopante. Este al ser dopado mejora notablemente su conductividad. En este proyecto de investigación se espera que las nanoestructuras semiconductoras de cobre puedan ayudar a contrarrestar el proceso de degradación enzimática de los hidrogeles. Podemos inferir que a través de la incorporación de las nanoestructuras de cobre se busca poder disminuir la tasa de degradación de los hidrogeles



June 03, 2022

We are recruiting peer leaders for our project for Fall 2022! If you are interested, please follow the instructions established in the following document.

May 23, 2022
Students from the Inter American University of Puerto Rico, Ponce and Bayamón Campus had excellent results in the RISE in STEM project sponsored by NSF.
https://www.vocesdelsurpr.com/2022/05/estudiantes-de-inter-ponce-se-forman-como-investigadores-en-stem/?fbclid=IwAR0clKWnKE-SOimzA0fwahBYVTlr21dMY7Q8WsnuK2DODnEInga5oerKzew

May 13, 2022
Students that participated in RISE in STEM presented their findings at the mini symposium "STARS in STEM"