

# SMART CLOTHING AND HIGH-PERFORMANCE BUILDING MATERIALS: A NOVEL USE OF NATURAL POLLEN GRAINS

## SUMMARY

The main objective of this project is to develop a novel and green method of synthesizing high-performance composites using natural and sustainable biopolymers, including cellulose, keratin from wool, and natural pollen grains. The composites obtained will have a unique set of properties: biocompatibility, hemostasis, wound healing, antibacterial, anti-inflammation, controlled delivery of drugs, and the ability to regulate the environment (i.e., cool down the hot environment and heat the cool environment). These properties will enable them to be used for a variety of applications, including smart textiles and building materials.

## DESCRIPTION

To avoid environmental pollution, it is important to develop smart materials entirely from biopolymers, which are green, sustainable, biocompatible and biodegradable. We propose to develop a novel and green method to synthesize smart materials entirely from naturally abundant biopolymers, such as cellulose, polysaccharides, wool, natural pollen grains and wax. We will achieve this objective by developing a novel and green method to process natural pollen grain into sporopollenin exine capsules (SECs) that are hollow spherical microcapsules (dia.  $\sim 25\mu\text{m}$ ) with extensive networks of  $\sim 200\text{nm}$  diam. holes. We will then encapsulate phase change materials (PCM) into the microcavity of the SEC and the resulting PCM@SECs will be incorporated into building and textile materials.

## MILESTONES

Fall 2019

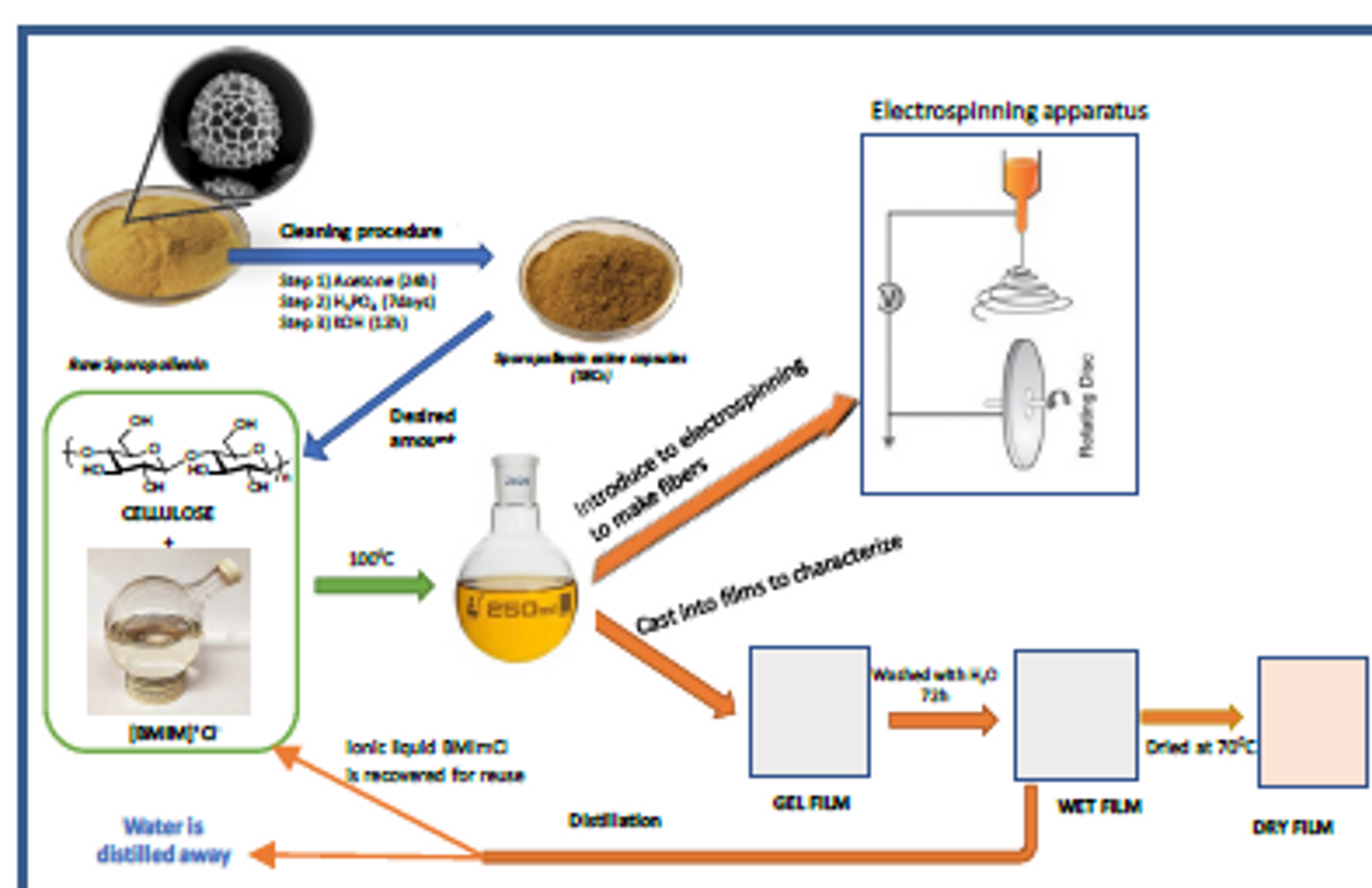
Develop and prepare SECs

Spring/Summer 2020

Incorporate PCM@SECs into composites, spin into fibers, and encapsulate probiotic *lactobacillus plantarum* (LP) and prebiotic mannan oligosaccharide (MOS)

## ABOUT OUR TEAM

- Dr. Chieu Tran, PI  
Professor of Chemistry, Marquette University
- Mark Mitmoen, Researcher  
Chemistry Graduate Student, Marquette University
- Mak Parajape, Collaborator  
Professor, Georgetown University



## BEYOND BOUNDARIES

Our project advances Marquette's strategic goals in the areas of Research in Action, Community Engagement, and Sustainability of Valuable Resources, by seeking collaboration with local weaving companies to develop novel methods of creating smart clothing using renewable, natural compounds. SECs are the first completely natural and biocompatible microcapsules that can encapsulate probiotics and prebiotic, ensuring that they are both protected and reach the intestines fully retaining their bioactivity. Results obtained from this project are important to many different disciplines, including materials science, food chemistry, consumer product development.