Announcing the Final Examination of Abdullah Alqassar for the degree of Master of Science

Time & Location: November 6, 2019 at 9:30 AM in Engineering 2 442K
Title: Synthesis and Characterization of Biomimetic, Bioinspired and Bio-related Functional Polymers for Atmospheric Water Recovery

Atmospheric water recovery in changing environments has received wide attention in environmental science and engineering communities due to rapid population growth and frequent droughts. This study is focused on the design, synthesis, and characterization of biomimetic, bioinspired, and bio-related functional polymers (b3p) to help resolve the water supply issue especially in arid or semi-arid regions. It is aimed to develop unique synthetic methods to access well-defined polymers with the aid of nanomaterials and metal to produce next generation polymer materials for better atmospheric water recovery. The design of such new b3p is bioinspired by some skin materials of biological species such as frogs, beetles, or spiders. Such synthetic efforts are also coupled with fundamental studies of the polymer functions and structures, providing renewed understanding of how molecular structure and processing parameters associated with different nanomaterials impact macroscopic properties. This research was accomplished by using a class of cross-linked hydrophilic copolymers known as hydrogels that exhibit a high fluid absorbency, up to 1,000 times their own weight. Using free radical polymerization to crosslink two different monomers such as, acrylamide (Am) with Acrylic Acid (Aa) loaded with Calcium Chloride (CaCl2) and coated with gold nanoparticles (Au\(\text{Np}')s\), can produce novel thermally-responsive hydrophilic copolymer (Poly (Am\(\text{Aa}'\text{co-Aa}')\text{Au}'\text{Np}''/\text{CaCl2}) that was placed inside a controlled structure. The new b3p materials can swell water vapor in the evening and deswell water vapor in the morning. This study has successfully functionalized the hydrogel with Au\(\text{Np}'\)s that deswell 11% faster than a plain hydrogel. Also, the new b3p materials demonstrated high swelling percentage of about 2,571% when placed in water under a temperature range [30\(^{\circ}\text{C}]-40\(^{\circ}\text{C}\) for 5 hours. The hydrogel loaded with 0.4 grams CaCl2(s) that was placed under controlled relative humidity percentage range [80\(^{\%}\]-90\(^{\%}\) can recover up to 35% of the atmospheric water undergoing the same time and temperature conditions as those in the literature. The research concludes that the proposed synthetic method contributes to solving such contemporary challenge in green chemistry to some extent. Further studies are needed to deeply investigate the ability of this new hydrogel to load more dissolved solids such as CaCl2.

Major: Select

Educational Career:
Bachelor's of Environmental Engineering, BS, 2017, Wilkes University
Master's of Environmental Engineering, MS, 2019, University of Central Florida

Committee in Charge:
Ni\(\text{Bin Chang} , \text{Chair, Civil, Environmental, & Construction Engineering}
Lei Zhai, Department of Chemistry
Lorraine Leon, Department of Material Science and Engineering

Approved for distribution by Ni\(\text{Bin Chang} , \text{Committee Chair, on October 11, 2019.}

The public is welcome to attend.