

Sustainable nanomaterial production from biomass

Dr. Maobing Tu

Cellulose nanocrystals (CNC) is a kind of polysaccharide nano-scale material, which is able to be extracted from natural lignocellulosic biomass. Nanocellulose, including CNC and cellulose nanofibrils (CNF), presents exceptional properties, e.g. low density, high mechanical strength and modulus, large specific surface area, and reactive surfaces. These distinctive properties endow nanocellulose a variety of applications, for instance, reinforcing filler, rheological modifier, pharmaceutical carrier, biomedical implant, etc. Recently, the methods of nanocellulose extraction from biomass include chemical treatment, mechanical treatment, and a combination of both. In this research, a combination method including organosolv treatment using tetrahydrofuran (THF) and high-intensity (1,500 W, 20 KHz) ultrasonic nanofibrillation will be investigated for the CNC extraction from biomass.



Iridescent nanocellulose film
produced from biomass

The objective of this research is to fabricate the CNC using the proposed method with various conditions and investigate the properties of obtained CNC. The manufacturing process includes three steps: 1) mill biomass into 60-mesh size employing a grinder; 2) organosolv treatment of biomass in a high-pressure reactor under various concentration of solvent and temperatures; 3) separate the CNC products from biomass by a high-intensity ultrasonic. The obtained CNC will be characterized by scanning electron microscope (SEM), X-ray Diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), and others to identify the morphology, crystallinity, surface chemical and physical properties of the resultant CNC. The study is expected to demonstrate high efficiency of this combined process for nanomaterial production.