

**USDA/NIFA Program: *Biobased Products and Bioenergy Production Research***

**TITLE: Nano-Cellulose-Reinforced PLA for Polyolefin Replacement**

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**NON-TECHNICAL SUMMARY:** Petroleum-based products are being replaced with bioplastics, especially poly(lactic acid) (PLA). However, the PLA polymer does not have properties that allow it to compete directly with the mainstream petroleum-based plastics such as PE, PP, PS, and PVC. One avenue to improving the properties of PLA is by fabricating nanocomposites and utilizing special additives. Plasticizers already exist to tailor the flexibility of PLA to meet a variety of application requirements, but this comes at the cost of strength and stiffness. We propose the use of a nano-fibrillar material, microfibrillated cellulose (MFC), to strengthen and toughen PLA. MFC is a web-like material made of cellulose derived from wood. A recent development has significantly reduced the cost of this material so that it is now competitive with plastics. Tough and strong, MFC would be the ideal reinforcing material for PLA if the two were compatible. Unfortunately, they are not. However, in this proposal we will develop a coupling agency, or compatibilizer, that will allow MFC to disperse and reinforce PLA effectively. The resulting materials will be studied using advanced suite of analytical instrumentation and state-of-the-art mathematical models. By using an iterative procedure of testing various compatibilized MFC/PLA composites, feeding this into the models and using the results to design the next set of experiments, we will develop the technology to provide for the broadest possible design space for MFC/PLA nanocomposites.

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