University of Nebraska Lincoln | NEBRASKA CENTER FOR ENERGY SCIENCES RESEARCH

Cycle 5 – Energy Research Grants

Micro/Nanomechanical Studies of Switchgrass Composition and Cellulose Breakdown Kinetics

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ABSTRACT:

The goal of this project is to develop high-throughput micro/nanoscale engineering assays to quantify switchgrass composition (cellulose, lignin) and to quantify the kinetics associated with enzymatic breakdown of cellulose. This goal will allow ethanol production for a particular plant variety to be optimized more efficiently than current methods.

Production of ethanol or other fuels from cellulosic materials, such as switchgrass, relies on the breakdown of sugar polymer chains into simple sugars. Currently, there are two major limitations that restrict the overall efficiency of biofuel production. First, the selection process for plant traits that are ideal for production takes a very long time due to the lack of high-throughput screening methods. In addition, the pretreatment process for the biomass can rely on a nearly limitless number of enzymes. Thus, the combinations of genetic varieties of plants and enzymatic treatments is enormous such that the ethanol production process is difficult, if not impossible, to optimize in an efficient manner. It is cost prohibitive to study all combinations at the production scale. Recently nanoscale probing techniques have been developed at UNL for quantifying the properties of plant cell walls and for studying changes in cell wall composition.

The research is focused on expansion of these techniques in order to develop a combinatorial approach often used in materials science to the problem of plant trait screening and optimized pretreatment. The mechanisms and time scales of cellulose breakdown will be studied using switchgrass varieties and enzymes recommended by plant scientists. At the conclusion of this research project, several techniques will be available so that various combinations can be identified for further study at the laboratory production level.