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An Atomic Force Microscopy Study of the Mechanism of Cellulose Biodegradation AMANDA QUIRK, MAOHUI CHEN, DARRELL COCKBURN, SARAH REGLI, ANTHONY CLARKE, JOHN DUTCHER, JACEK LIPKOWSKI, University of Guelph, SHARON ROSCOE, Acadia University — Cellulose, a biopolymer consisting of long chain β-(1$\rightarrow$4) linked glucose sugars, is used as structural material by plants and bacteria. Degradation of cellulose to glucose, a sugar easily fermented to ethanol, occurs by the enzymatic hydrolysis of cellulose by cellulase enzymes. The enzymes have a complex structure including carbohydrate binding modules and catalytic domains responsible for the binding and degradation of cellulose, respectively. Atomic force microscopy (AFM) was used to study native cellulose films prepared from Acetobacter xylinum using a novel application of the Langmuir-Blodgett technique. These films allowed AFM images of single fibers and their microfibril structure to be obtained. Further *in situ* AFM studies of single fibers were performed in solution using cellulolytic enzymes. The *in situ* degradation of cellulose fibers was monitored over 20-hours using AFM. These studies provided insight into the degradation timeline of a single fiber. Complementary studies of proteins adsorbed on cellulose fibers revealed information about the binding of the enzymes to the substrate. Studying the modular enzyme action separately will provide insight into the mechanism of cellulose binding and contribute to our understanding of the degradation process.

Amanda Quirk
University of Guelph

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