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Conversion of biomass to biofuels by bacterial cellulosomes[1]

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Lignocellulosic biomass waste has the potential to be converted to biofuels and other value-added chemicals in a renewable manner. However, a cost-effective depolymerization of polysaccharides is challenging technologically. In order to take on the challenge, one can use cocktails of bacterial or fungal enzymes, known as cellulases. Another promising approach, discussed here, is to employ certain bacteria, such as Clostridum thermocellum, that grow extracellular molecular complexes known as cellulosomes. A cellulosome mounts many different cellulases on a nonhydrolytic structural unit consisting of a number of the cohesin domains. The domains bind to their complementary dockerin domains belonging to the catalytic subunits. In this lecture, I will highlight results of the experimental and theoretical research on cellulosomes performed by the European consortium CellulosomePlus[1] (Cajal Institute in Madrid, Weizmann Institute in Rehovot, Ludwig Maximillian's University in Munich, Institute of Physics in Warsaw, Oceanography Institute in Roscoff, University of Limerick and three industrial partners). The goals of the consortium include characterization and understanding the structure and function of several cellulosomes as well as the development of designer cellulosomes that would be more effective than their wild type versions. The subjects covered in the lecture include the role of the linkers on the properties of cellulases, effects of singlesite mutations on the mechanical and thermodynamic stabilities of cohesin c7A in the cellulosome of C. thermocellum, the non-local impact of such mutations, the mechanics of the cohesin-dockerin interface, protein-hexaose and protein-cellulose interactions, and the status of the implementation efforts. [1]The European Framework Programme VII NMP grant 604530-2 (CellulosomePlus)