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Cellulosome-inspired multi-enzyme assemblies for conversion of cellulosic biomass into biofuels

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Cellulose is the major component of the plant cell wall and as such comprises the most abundant renewable source of carbon and energy on our planet. This fact has spawned, in the last decade, a tremendous amount of interest in the use of cellulosic biomass to at least partially alleviate the burden and dependence of our society on fossil fuels. In the plant cell wall, however, cellulose and other polysaccharides assume a structural rather than a storage role, and their monosaccharide residues – whose facile production is the key to the subsequent processing of liquid biofuels – are essentially inaccessible to microbes and their polysaccharide-degrading enzymes. Unlike aerobic fungi and bacteria, various anaerobic bacteria secrete potent multi-enzyme cellulosome complexes, which contain numerous cellulases, hemicellulases and associated enzymes, attached to the bacterial cell surface, thus enabling efficient degradation of cellulosic substrates. We have exploited the enhanced synergistic properties of cellulosomes by reconfiguring their Lego-like multi-modular components into discrete artificial complexes of predetermined design. We have thus dismantled the cellulosome into its component parts and reassembled them into "designer cellulosomes" of precise content and organization. Designer cellulosomes provide a promising platform for understanding the rationale behind its catalytic efficiency, and knowledge gained from their study may provide the basis for creating improved multi-enzyme assemblies for efficient cost-effective conversion of plant-derived biomass into liquid biofuels.

Biography

Edward A Bayer is a Professor in the Department of Biological Chemistry at the Weizmann Institute, Rehovot, Israel. In his early work, he helped develop the avidin- and streptavidin-biotin system as a general tool in the biological sciences. He is co-discoverer of the multi-enzyme cellulosome concept and has organized and chaired Gordon Research Conferences on this subject. He has also pioneered the development of designer cellulosomes for research and biotechnological applications. He has authored over 350 articles and reviews in these fields, is editor or serves on editorial boards of several journals in the field of biotechnology, on the scientific advisory board of the DOE BioEnergy Science Center (BESC), and was elected to Fellowship of both the American Academy of Microbiology and the European Academy of Microbiology. His interests focus on the structural and functional consequences of protein-protein, protein-carbohydrate and protein-ligand interactions, protein engineering, synthetic biology, nanobiotechnology, microbial and enzymatic degradation of plant biomass and biomass-to-biofuels processing.

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