A Molecular Description of Cellulose Biosynthesis

Biological polymers, such as polypeptides, nucleic acids and polysaccharides, are frequently translocated across at least one membrane to reach their site of biological function. Cellulose is a linear polymer of glucose molecules and a common biofilm component that is synthesized and secreted by a membrane-integrated cellulose synthase. We used in crystallo enzymology with the catalytically active bacterial cellulose synthase BcsA-B complex to obtain structural snapshots of a complete cellulose biosynthesis cycle, from substrate binding to polymer translocation. Substrate- and product-bound structures of BcsA provide the basis for substrate recognition and demonstrate the stepwise elongation of the polymer. Furthermore, the structural snapshots show that BcsA couples polymer elongation with membrane translocation via a ratcheting mechanism involving a ‘finger helix’ that contacts the polymer’s terminal glucose unit. In cooperation with BcsA’s gating loop, the finger helix moves ‘up’ and ‘down’ in response to substrate binding and polymer elongation, respectively, thereby pushing the extended polymer into BcsA’s transmembrane channel.

Monday, April 11, 2016
4327 Stevenson Center
3:10pm – 4:00pm
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Reception at 2:45pm.