Optotracing: Getting the most out of plant biomass

Ferdinand X. Choong, Linda Lantz, Hamid Shirani, Anette Schulz, K. Peter, R. Nilsson, Ulrica Edlund, Agneta Richter-Dahlfors

Video Abstract

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Abstract

Take. Make. Dispose. Long the mantra of modern industry, this linear model of economic growth is unsustainable. It has drained the planet of natural resources and amplified the climate-altering effects of human activity. Fortunately, it's not too late to turn it around. The United Nations' 2030 Agenda for Sustainable Development outlines a plan of action for preserving peace, people, prosperity, and our planet. Central to that plan is the promotion of a new industrial model of reduction, reuse, and recycling. Scientists from Sweden are taking up that cause in an unlikely but impactful place: inside plants. Biomass is a highly underutilized natural resource. Currently, humans use only about 3.5% of net growth of global biomass. It's not hard to envision how adding more biomass to the world's current energy mix could substantially offset harmful fossil fuels. Add to that the numerous non-energy applications of biomass, especially that derived from plants, in the food and beverage, pharmaceutical, and chemical industries. But making the most out of that biomass has proved tricky. The sugar-based materials in a plant's anatomy are chemically distinct, each pertinent to a unique range of applications. Cellulose, for example, is extensively used to produce paper and textiles and is one of the most commonly utilized organic compounds on earth. Similarly, alginate and starch make excellent stabilizers and gelling agents in food and drink. Unfortunately, targeting each component for extraction is extremely difficult, as they can be extremely similar, and analysis is almost always destructive. Now, there might be a better way. The Swedish team of scientists has created chemical tracers that differentiate between the various deposits of raw material found in plants. The tiny chemical tags are designed to flex to varying degrees when they latch onto different plant sugars. Because the tags are optically active, probing with a laser results in a unique signature for each type of pairing. Potato tissue soaked with a single type of so-called optotracer yielded a map of the cellulose- and starch-rich compartments: cellulose along the walls and starch in-between. That extremely high sensitivity to minute variations in chemical structure could prove invaluable to biomass sourcing. Optotracing could help researchers in both industry and academia gain a better understanding of biomass components and thereby optimize processing methods. Ultimately, the technique could provide a much-needed boost in targeting efficiency, spurring the push toward the circular economy envisioned by the 2030 Agenda.