Technique could lower cost of making bioplastics and biofuel

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Ulrica Edlund, Professor of Polymer Technology at KTH Royal Institute of Technology. Credit: KTH Royal Institute of Technology

The potential for at least partly replacing oil with cellulose as a renewable source of energy and materials has just improved.

While abundant in nature, cellulose is difficult and expensive to find in pure or high-quality form. Now, however, a Swedish research team involving researchers from KTH Royal Institute of Technology in Stockholm and the Karolinska Institute has developed an efficient, accurate and non-destructive way to detect the occurrence and purity of cellulose. The technique, which was published in *Scientific Reports*, can be applied in mixtures of biopolymers, as well.

Cellulose is a major component of all plant matter – one of Earth's most abundant molecules. As a long and strong polymer, it has been used as a material for textiles and packaging. Scientists have also developed the means to break down cellulose to make biogas.

According to Ulrica Edlund, professor of Polymer Technology at KTH, "the ability to bottom-up assess and understand the lignocellulosic biomass composition is a key enabling technology in the emerging biorefinery sector."

The problem with cellulose is that it is rarely found in a pure form. What's more, the quality of isolated cellulose varies when industrial techniques are used to fractionate it—that is, to deconstruct the matter and sort it out according to structural characteristics such molecular structure and molecular weight.

Not being able to accurately assess the quality and purity is making recycling and manufacturing processes more difficult and less efficient, Edlund says. This leads to unnecessary waste in recycling, which is costly and damaging to the environment. It also means that it is difficult to monitor the quality of the breakdown of cellulose to biogas.

The researchers have synthesized a nontoxic molecule that can be easily applied to different forms of cellulose and provide a simple optical readout of quality. This could be used routinely and safely at any part of the cellulose-processing pipeline, giving multiple options for deployment and optimization.

Current methods of quantifying cellulose are technically demanding and typically require harsh chemical pre-treatments in order to degrade the polymers for analysis. The traditional methods also suffer from difficulties in the scale-up process owing to the large quantities of dangerous chemicals required and the scarce access to complex analysis

machinery.

The next step for this technology is to make it available to industries that rely on cellulose, as well as creating new, safe detection systems that reduce the reliance on dangerous chemicals and improve the quality efficiency of the recycling process.

More information: Ferdinand X. Choong et al. Nondestructive, real-time determination and visualization of cellulose, hemicellulose and lignin by luminescent oligothiophenes, *Scientific Reports* (2016). DOI: 10.1038/srep35578

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