NREL Highlights RESEARCH & DEVELOPMENT

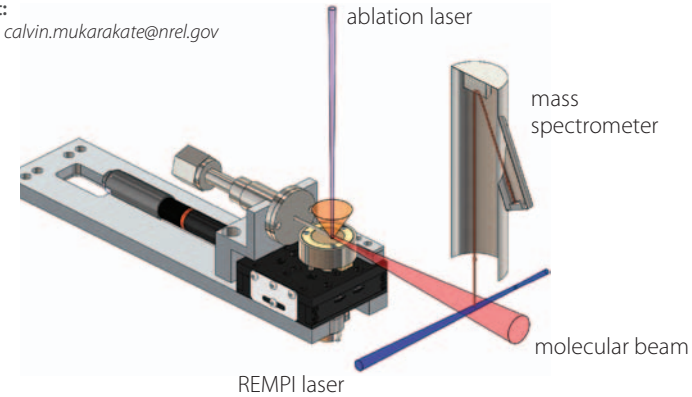
New Combined Laser Ablation Platform Determines Cell Wall Chemistry

NREL has designed and developed a combined laser ablation/pulsed sample introduction/mass spectrometry platform that integrates pyrolysis and/or laser ablation with resonance-enhanced multiphoton ionization (REMPI) time-of-flight mass spectrometry. Using this apparatus, we can measure the cell wall chemical composition of untreated biomass materials.

Understanding the chemical composition of untreated biomass is key to both the biochemical and thermochemical conversion of lignocellulosic biomass to biofuels. In the biochemical conversion process, the new technique provides a better understanding of the chemistry of lignin and will improve accessibility to plant sugars. In thermochemical conversion, the information provided by the new technique may help to reduce the formation of unwanted byproducts during gasification.

NREL validated the ability of the system to detect pyrolysis products from plant materials using poplar, a potentially high-impact bioenergy feedstock. In the technique, biomass vapors are produced by laser ablation using the 3rd harmonic of an Nd:YAG laser (355 nm). The resulting vapors are entrained in a free jet expansion of helium, then skimmed and introduced into an ionization region. REMPI is used to ionize the vapors because it is highly sensitive for detecting lignin and aromatic metabolites. The laser ablation method was used to selectively volatilize specific plant tissues and detect lignin-based products from the vapors with enhanced sensitivity. This will allow the determination of lignin distribution in future biomass studies.

Technical Contact:
Calvin Mukarakate, *calvin.mukarakate@nrel.gov*



Key Research Results

Achievement

NREL designed and developed a combined laser ablation platform to measure the cell wall chemical composition of untreated biomass materials.

Key Result

The new technique provides a better understanding of the chemistry of lignin and will improve accessibility to plant sugars in the biochemical conversion process. In thermochemical conversion, the information provided by the new technique may help to reduce the formation of unwanted byproducts during gasification.

Potential Impact

This combined platform used for the measurement and analysis of biomass cell walls will lead to improved biomass conversion technologies and bring the United States closer to the production of large-scale, economically viable lignocellulosic biofuels.

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

1617 Cole Boulevard | Golden, Colorado 80401-3305 | 303-275-3000 | www.nrel.gov

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