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Renewable Low-Cost Carbon Fiber for Lightweight Vehicles Workshop

Part 3: Unconventional CF: Resources, Challenges, and Opportunities

Breakout Session 3: Consolidated Findings

June 5, 2013

This slide deck summarizes the results of a public workshop sponsored by DOE/EERE in Detroit, Michigan, on June 4–5, 2013. The views and the opinions of the workshop attendees do not necessarily reflect those of the United States Government nor any agency thereof, nor do their employees, make any warranty, expressed or implied, or assume any liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights.

Questions for Discussion – Part 3

Breakout 3—Unconventional CF: Resources, Challenges, and Opportunities

- What are other pathways to CF from biomass resources beyond “drop-in” intermediates?
- What previous work on lignin-derived CF can be leveraged as new sources of clean lignin become available?
- How can lignin be used in other, non-structural materials for vehicles?
- What other applications exist or can be created for an unconventional CF?

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Other pathways to CF from biomass resources beyond "drop-in" intermediates

- Lignin
  - Different lignin structures, including improved understanding of structure vs. processability
- Cellulose
  - Fibers regenerated from cellulose to make carbon fiber, e.g. rayon
- Genetic modification of plants for specialized feedstocks
  - Lignin with desirable qualities (more S-lignin, straight polymers)
  - Synthesize extractable polymers, including those that contain nitrogen for easier conversion to PAN-like materials
- Other bio-derived precursors
  - Fatty acids, olefins, pitch or rosin-like pathway, bio-oils, chitin
- Blended CF (e.g. PAN + Lignin + Rayon + Pitch)
- Vapor grown carbon fibers
- CO_2
- Carbon nanotubes

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Key previous work on lignin-derived CF

- Catalogued library of lignin, methods, and chemical and mechanical properties, including reliable sources of lignin
- ORNL
  - Clear summary of what has been tried, what has failed → advanced analytics
  - Evaluations of kraft lignin → understanding of other isolation processes
- VTO
  - Review of funded efforts would be valuable, in particular Zoltec/Weyerhauser work
- Utilize advances in lignin genetics to tailor lignin for carbon fiber production
- Economic tradeoffs of processing technologies
- Lessons from petroleum industry

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Other uses for lignin
(in non-structural materials for vehicles)

- Vehicle applications
  - Semi-structural chopped fiber components
    - Several examples here: seat frames, door inner modules, mirror housings, Air splitters, front wheel wells, roof inner panels, bumper beams, etc.
- Coatings
- Electric car industry
  - Battery electrode materials and other battery materials for light weighting
- Others:
  - Insulation, flame retardant materials, dispersants for polyester dyes, tires, interior appearance components, audio system, replace glass fiber with carbon fiber (less demanding property requirements)
- Key need for evaluating applications: develop a list of specifications for all potential CF applications in vehicles

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Do any other applications exist/can be created for an unconventional CF

- Almost any industry that can use a lower grade CF that can act as a drop-in to an existing process
- Some applications include:
  - Vehicles: Corrosion-resistant materials, brakes, pigment and fillers for tires to replace carbon black
  - Marine and heavy truck applications
  - Road and bridge infrastructure
  - Electrical transmission lines
  - Flame proofing
  - Medical applications
  - Filters for selective gas removal
  - Fiberglass replacement
  - Fabrics
  - Sporting goods
  - Art, acoustics

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