
LIGNIN-BASED CARBON FIBER
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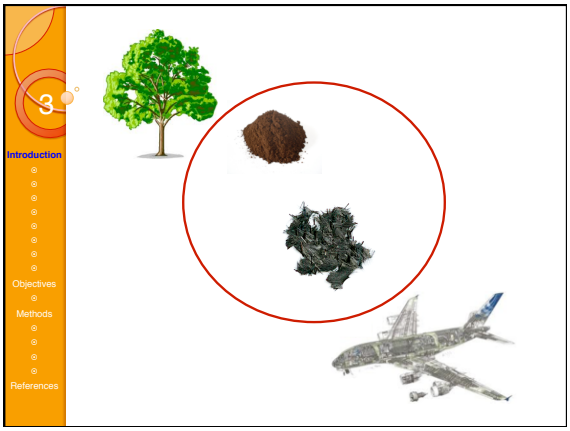
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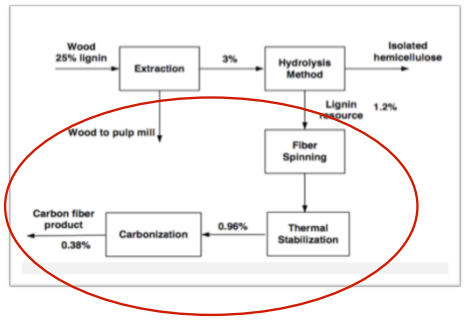
My project area at CRC



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Introduction

At present, the majority of carbon fiber is manufactured from polyacrylonitrile (PAN) starting materials while a small amount is derived from pitches.

However, due to the high cost of these petroleum-based precursors and their associated processing costs, carbon fiber remains a specialty product and as such has been largely limited for use in aerospace, high-end sporting goods, and special industrial applications.

Current work towards the manufacture of low-cost carbon fiber is limited to a small number of organizations.

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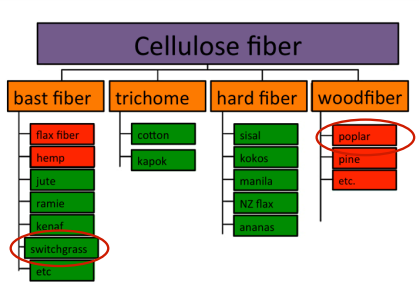
natural fibers



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natural fibers


flax


kapok


kenaf


switchgrass


poplar


jute

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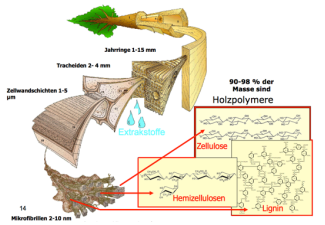
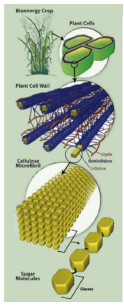
woody biomass - lignin





Lignin production = 50 million tons/year
(as a by-product of pulp & paper industry)

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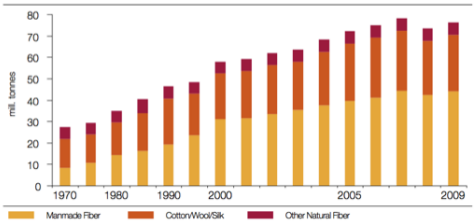
World fibers supply



just 33.000 tons – carbon fiber !!

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synthetic / manmade fibers

made from synthesized polymers,

come from petroleum based chemicals

pitch / pan / tar -> oil, gas & coal

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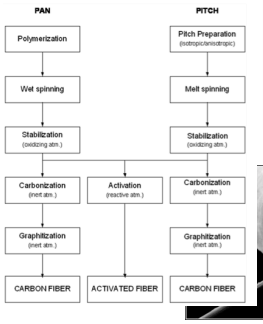
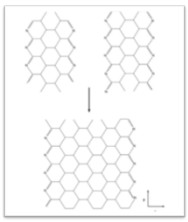
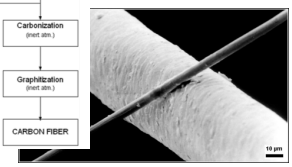
carbon fiber





crosslinking at 240-260°C



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Research Objectives

I woody biomass -> Lignin

II Lignin -> Carbon Fiber

The objectives of this tasks are to optimize the melt spinning and the carbonization of select improved lignins to produce carbon fiber of superior performance.

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Research Objectives

Our project team will manufacture high strength, low-cost carbon fiber.

Phase I — woody biomass -> Lignin
recover inexpensive optimized organosolve and biorefinery lignins for the manufacture of high strength low-cost lignin-based carbon fiber.

Phase II — Lignin -> Carbon Fiber
manufacture improved lignin-based carbon fiber with high strength and a target cost of $6.6/Kg (cost of conventional PAN carbon fiber = $12.5/Kg up to $25.43/Kg depending on process)

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Proposed Methods

Carbon fiber production:

1 - pelletization & fiber spinning

2 - carbonization

3 - carbon fiber analysis

4 - composite manufacture & analysis

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1) Pelletization & fiber spinning

Prior to fiber melt-spinning, the improved lignins will be dried and pelletized using a pilot-scale melt-spinning unit.
The smallest possible diameter will be used for the conversion into **carbon fiber…**

2) Carbonization / graphitization

The stabilized lignin fiber tows will be placed on a ceramic form in a furnace and typically heated to 500°C and then to 1000°C.

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3) Carbon fiber analysis

The carbon fiber will be evaluated for several performance parameters, including bulk density and **tensile strengths**. Their tensile properties will be measured by single-filament testing, according to ASTM standard D3379-75

4) Composite manufacture & analysis

Selected carbon fibers, with the best properties, will be manufactured on a larger scale and provided to a partner company to manufacture composites.

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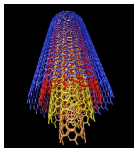
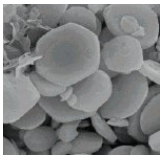
Further Investigations – nanomaterial composite carbon-fiber

With this gained carbon fiber (10g) different blend with nanomaterial will be investigated. On the one hand carbon fiber is mixed with nanotubes and on the other hand nanoplates are added.





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Further Investigations – nanomaterial composite carbon-fiber

	0.1	0.25	0.5	1.0	2.0	4.0	8.0
Nanotubes1							
Nanoplates1							
Nanoplates2							
Nanoplates3							
Nanoplates4							
Nanoplates5							

- 5 different types of mixtures
- 7 levels
- Further investigations with 3 levels of best performance

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Acknowledgements

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latest project from BMW – “black gold”

… any Questions ?