

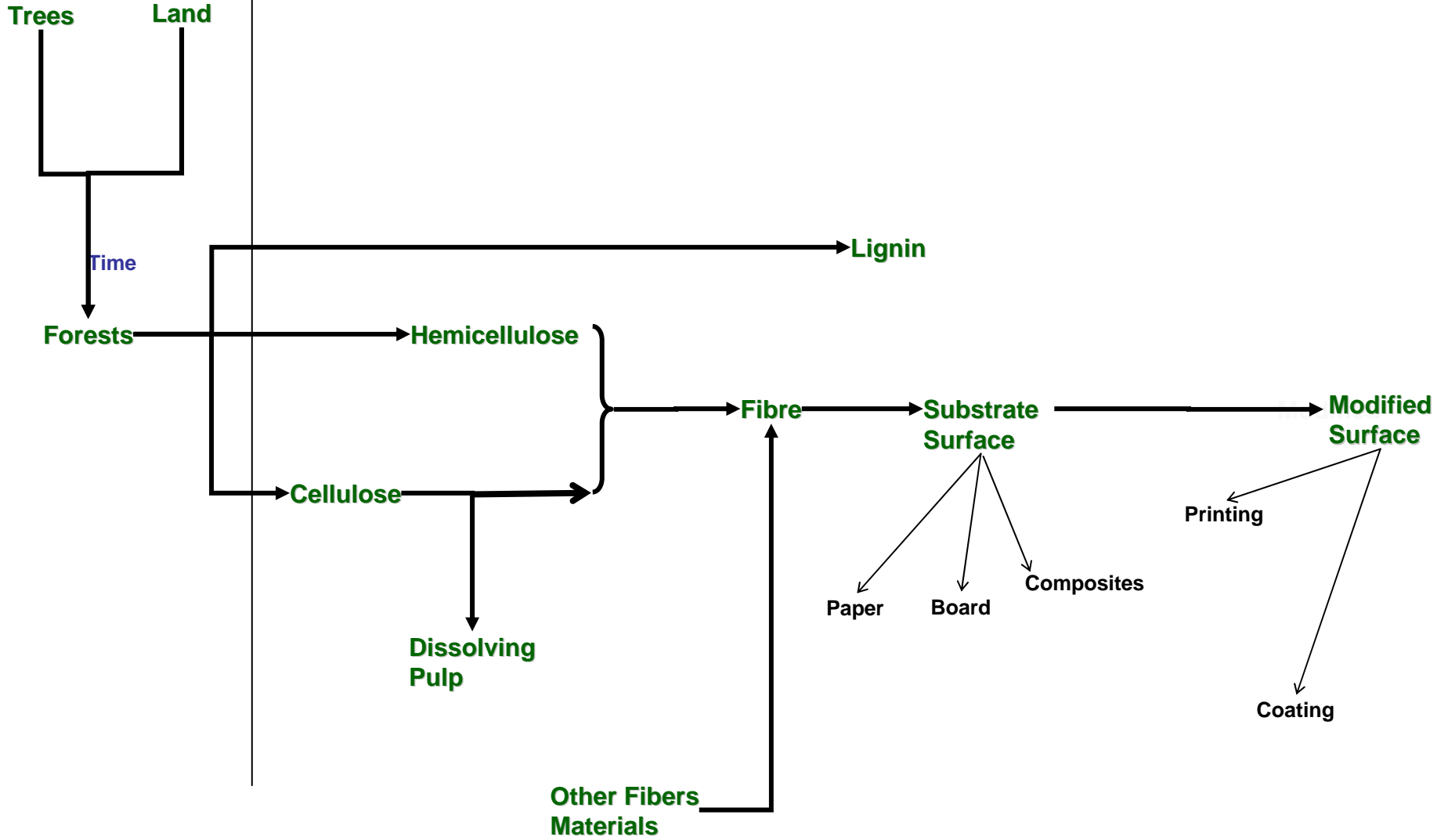
Forest products and Nanotechnology Roadmap

Steven L. Masia
SAPPI Fine Paper

Resources

End Results

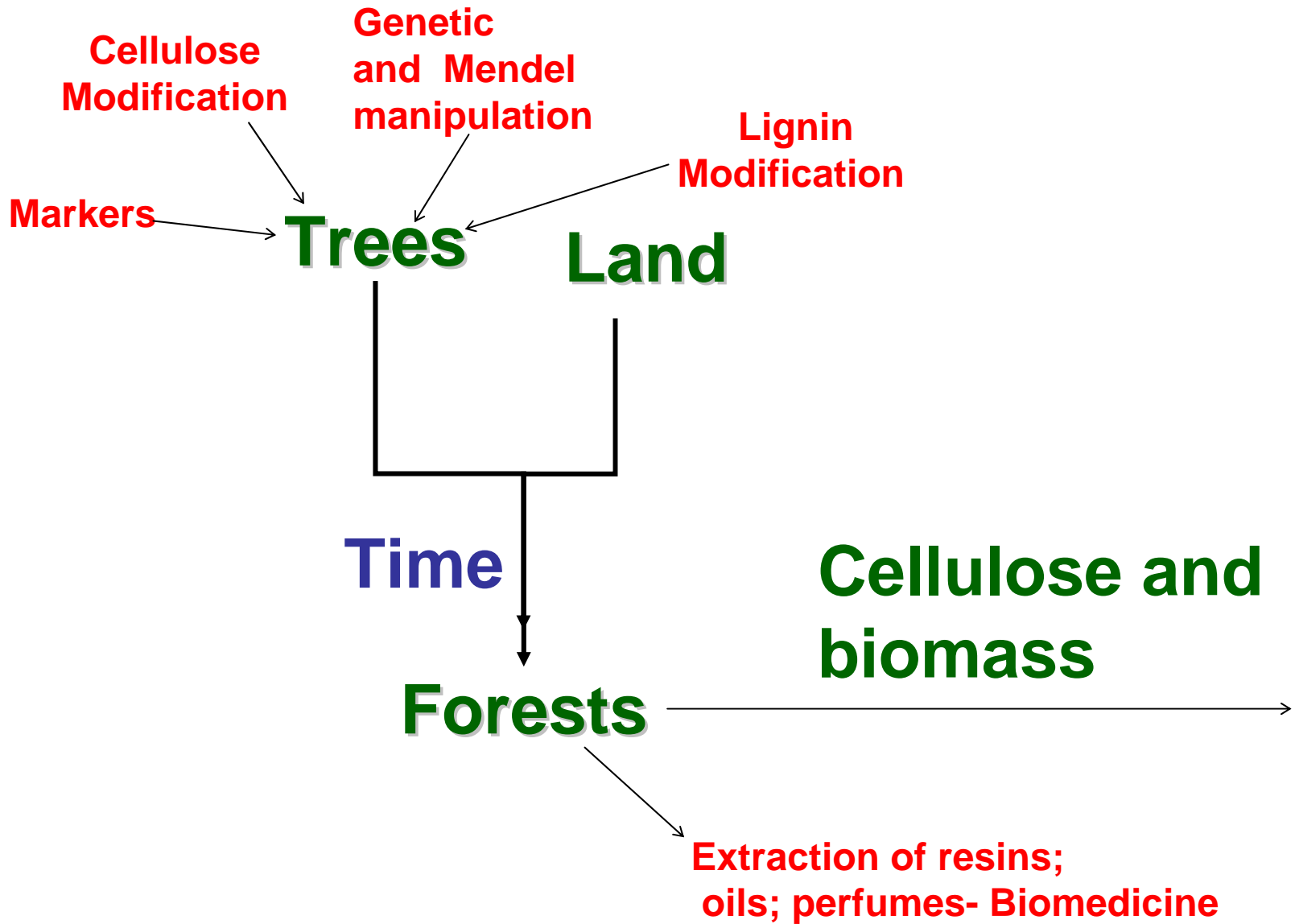
Standard Forest products Roadmap



Where can nanotechnology be
applied

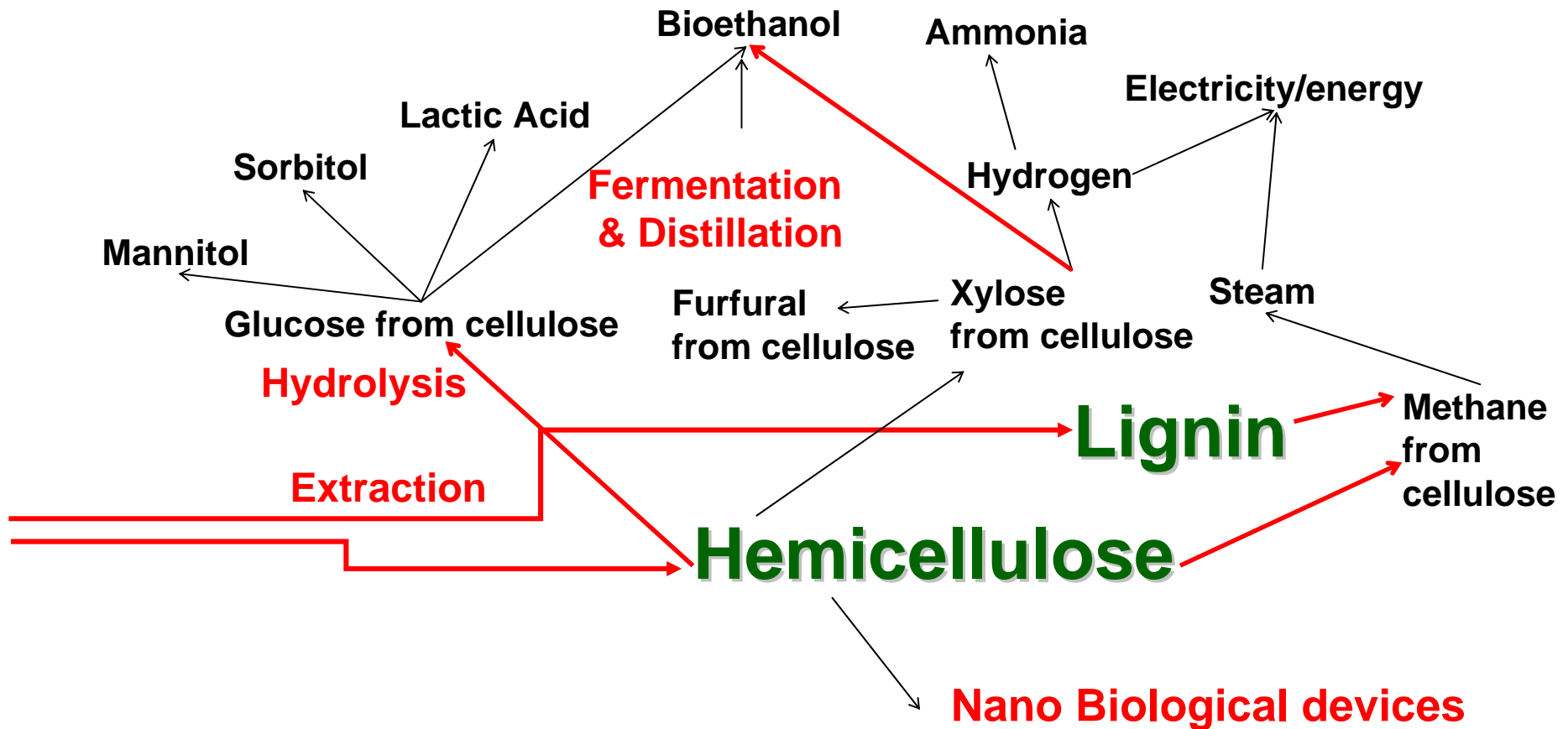
Look at each area:

Potential Nanotech applications
in red

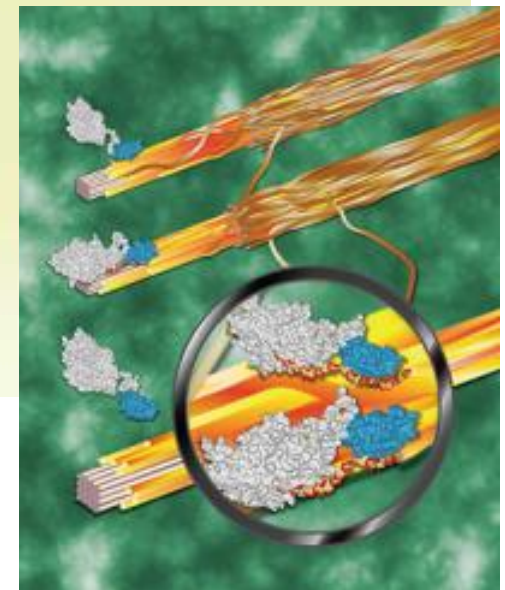
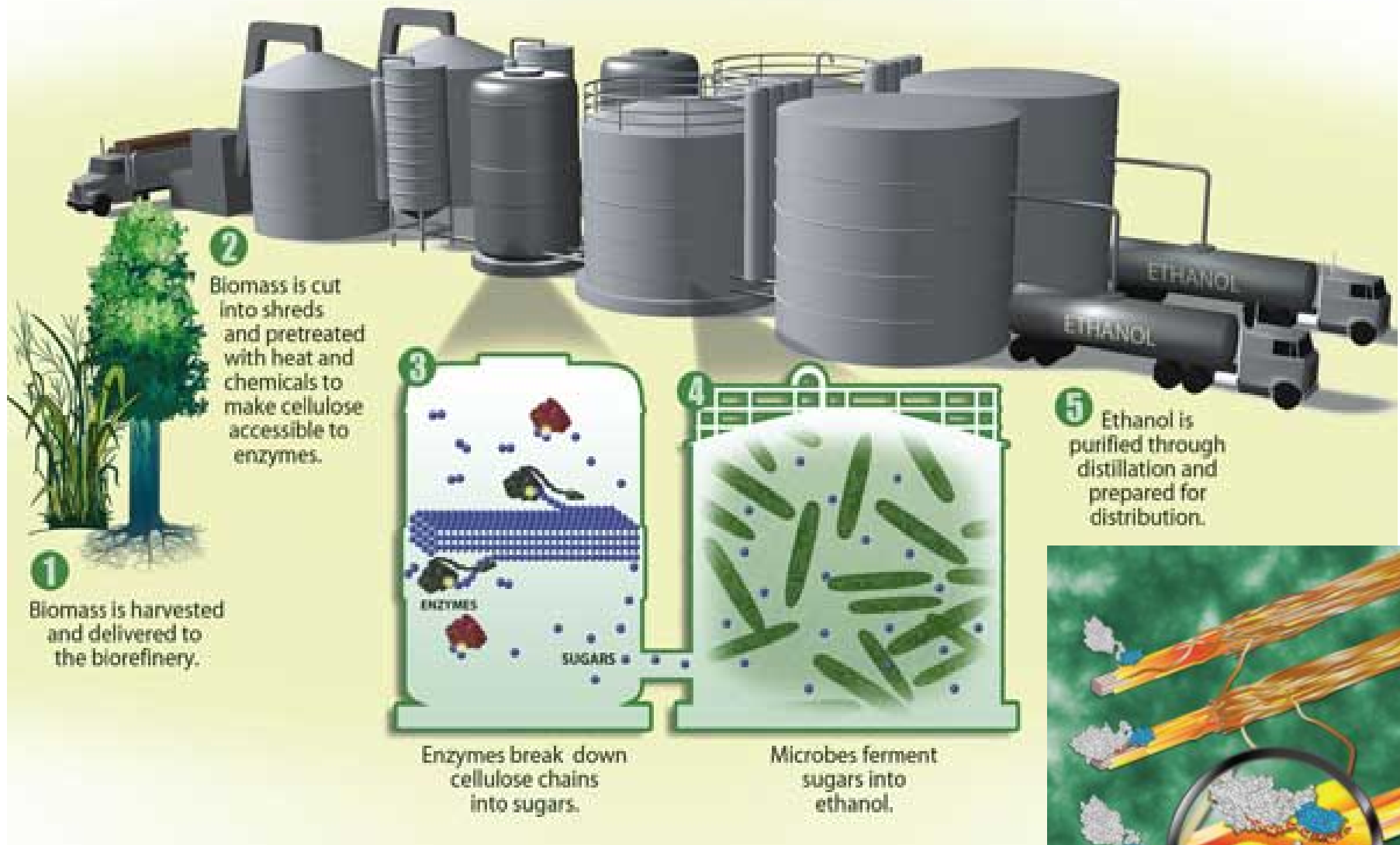


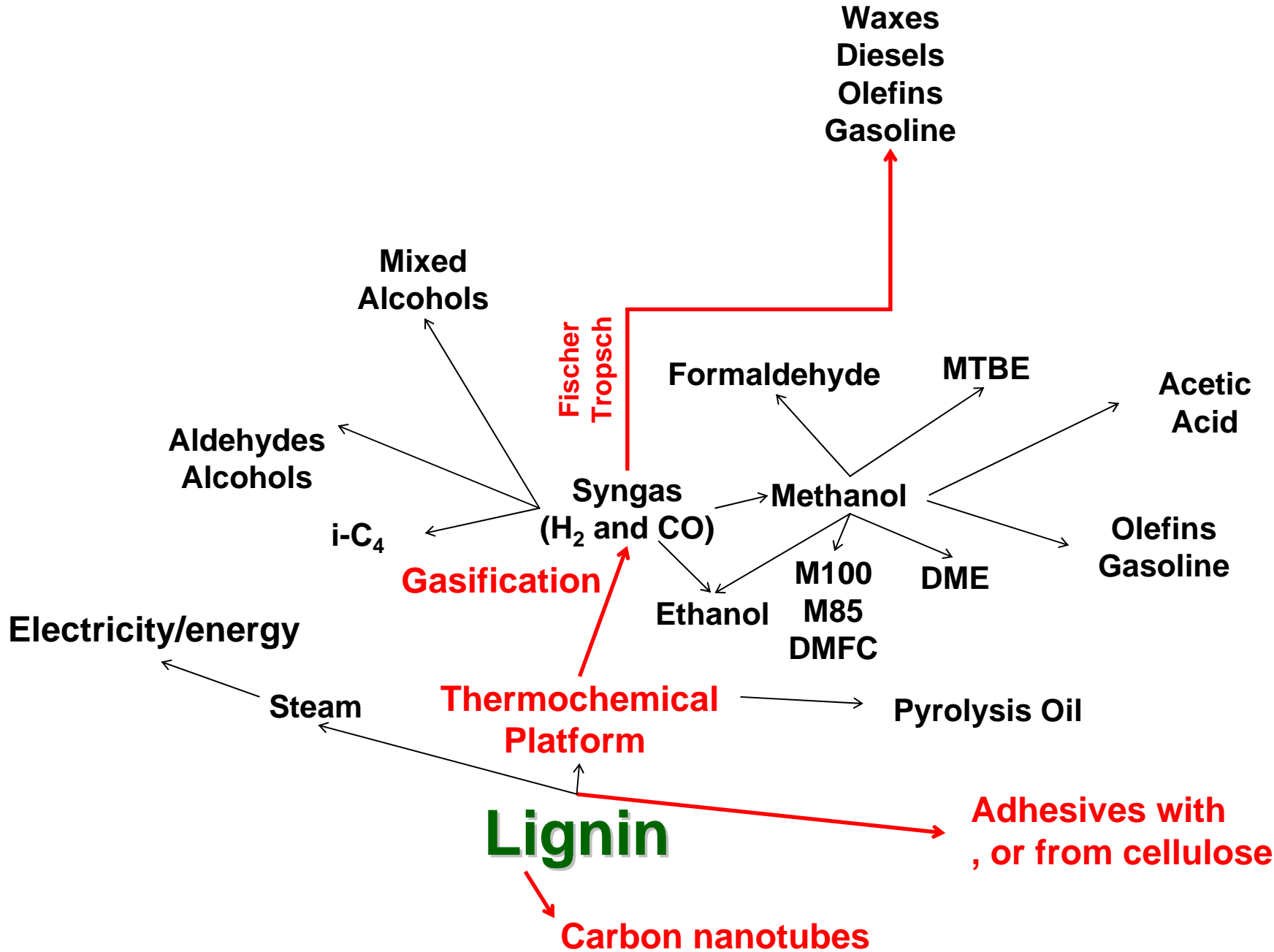
Genetic Modification of trees



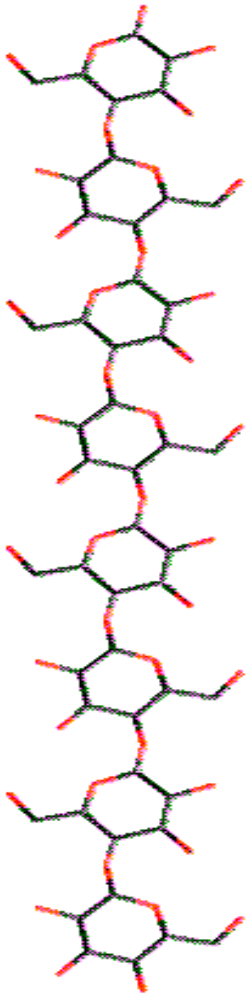


How Cellulosic Ethanol is Made

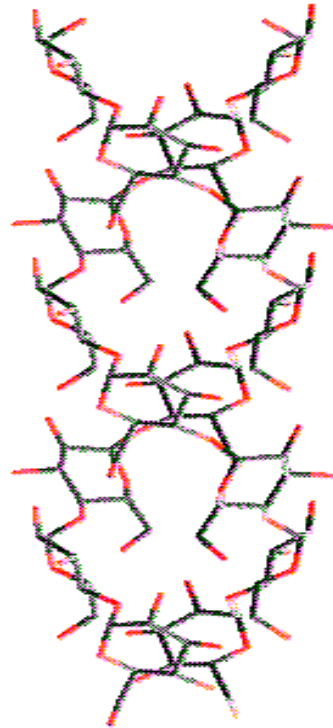




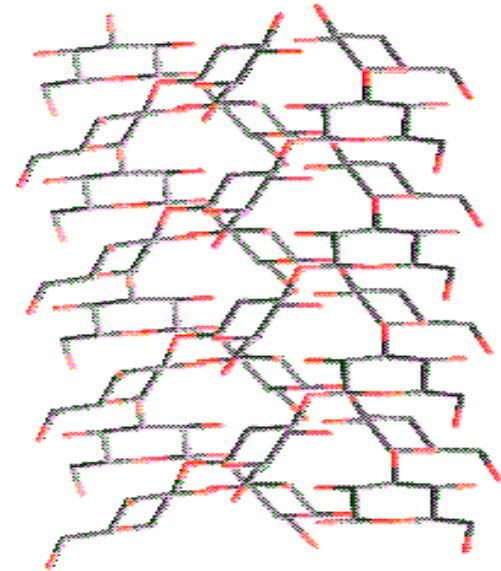
Cellulose Nanowire



Cellulose Chiral strand

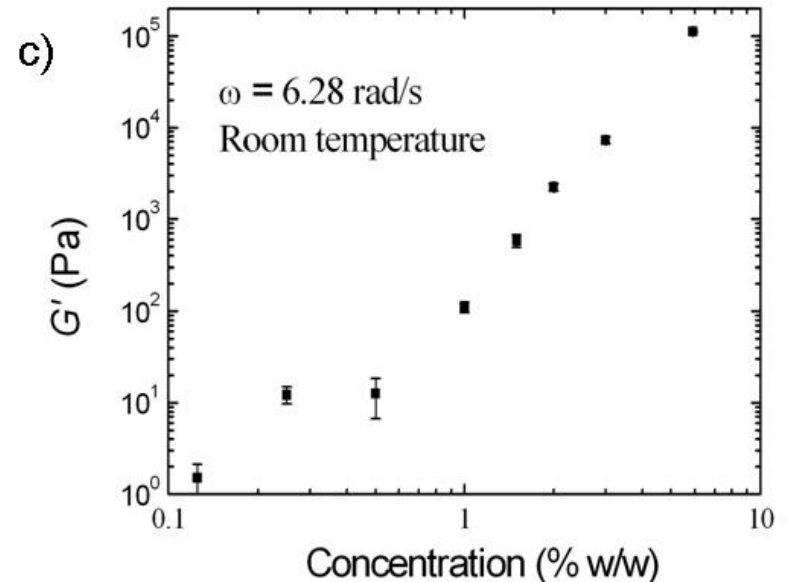
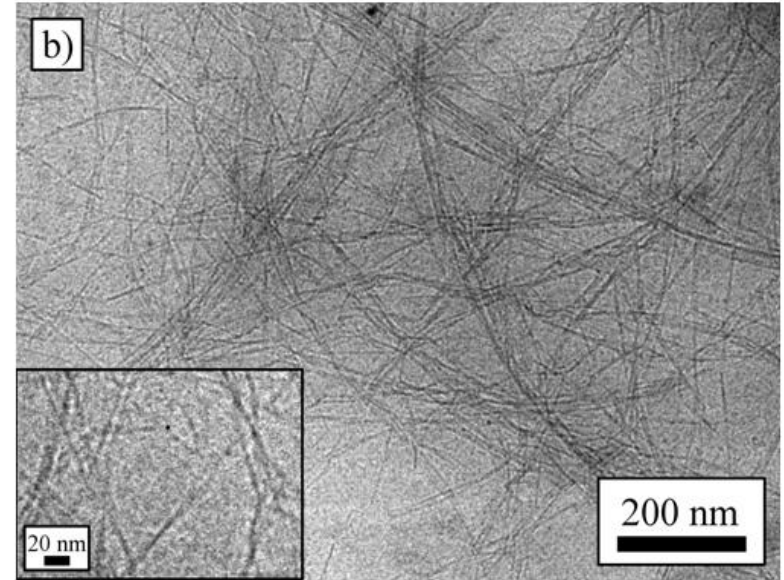
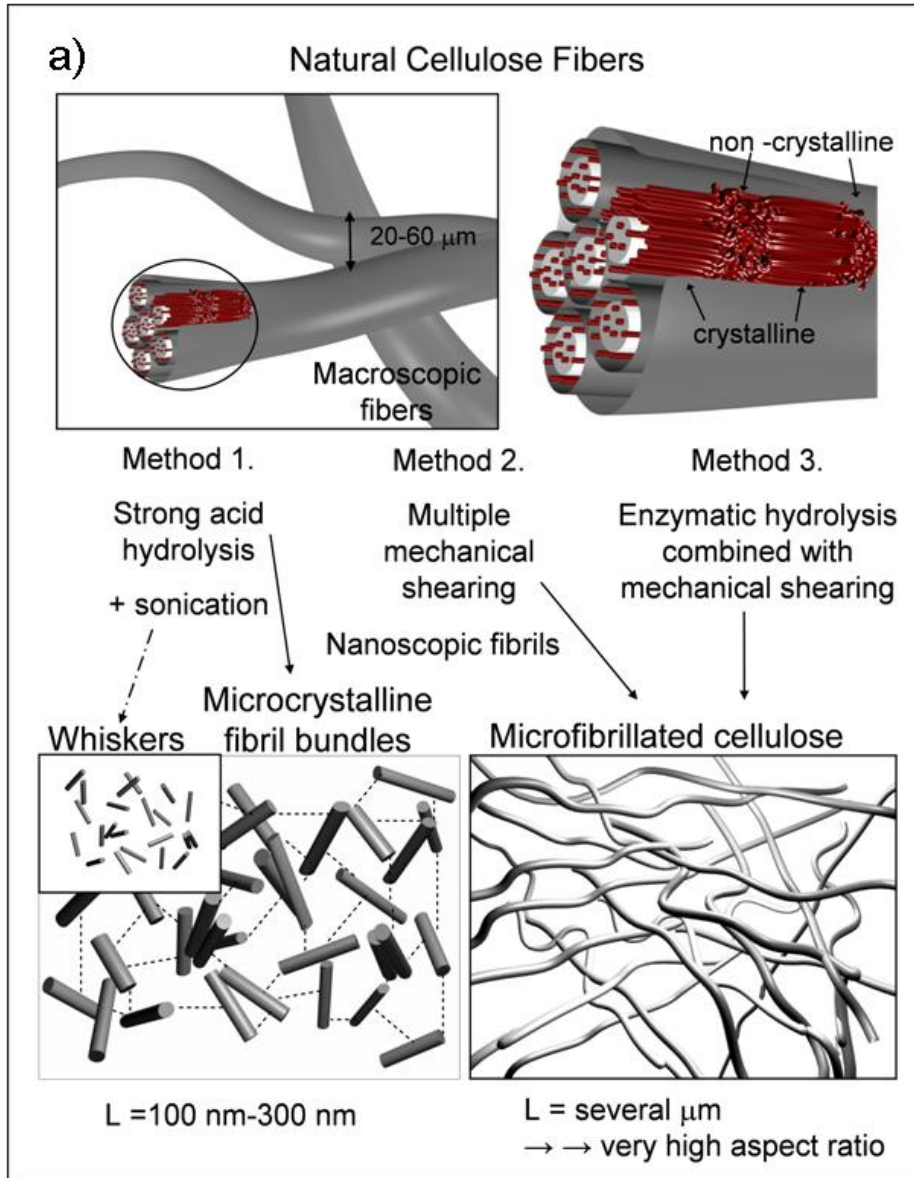


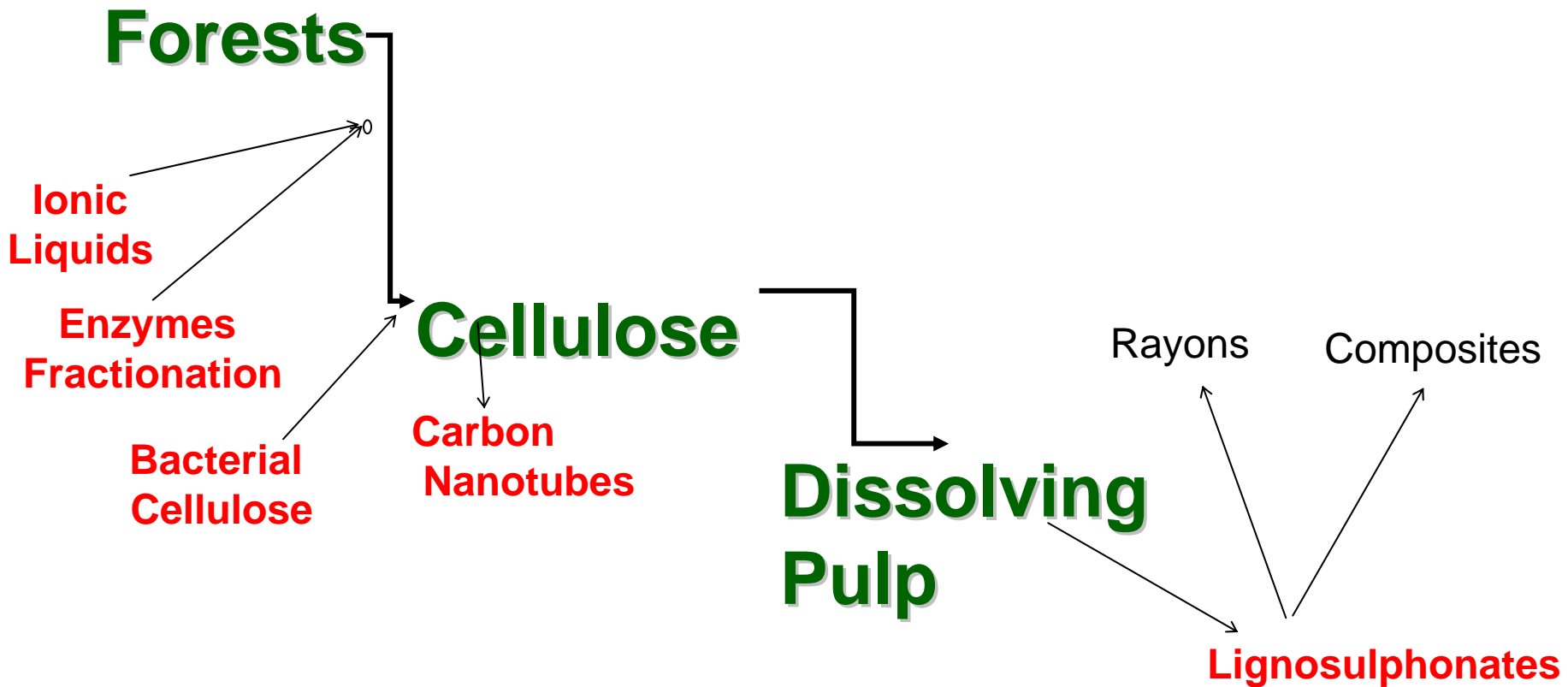
Double helix winding

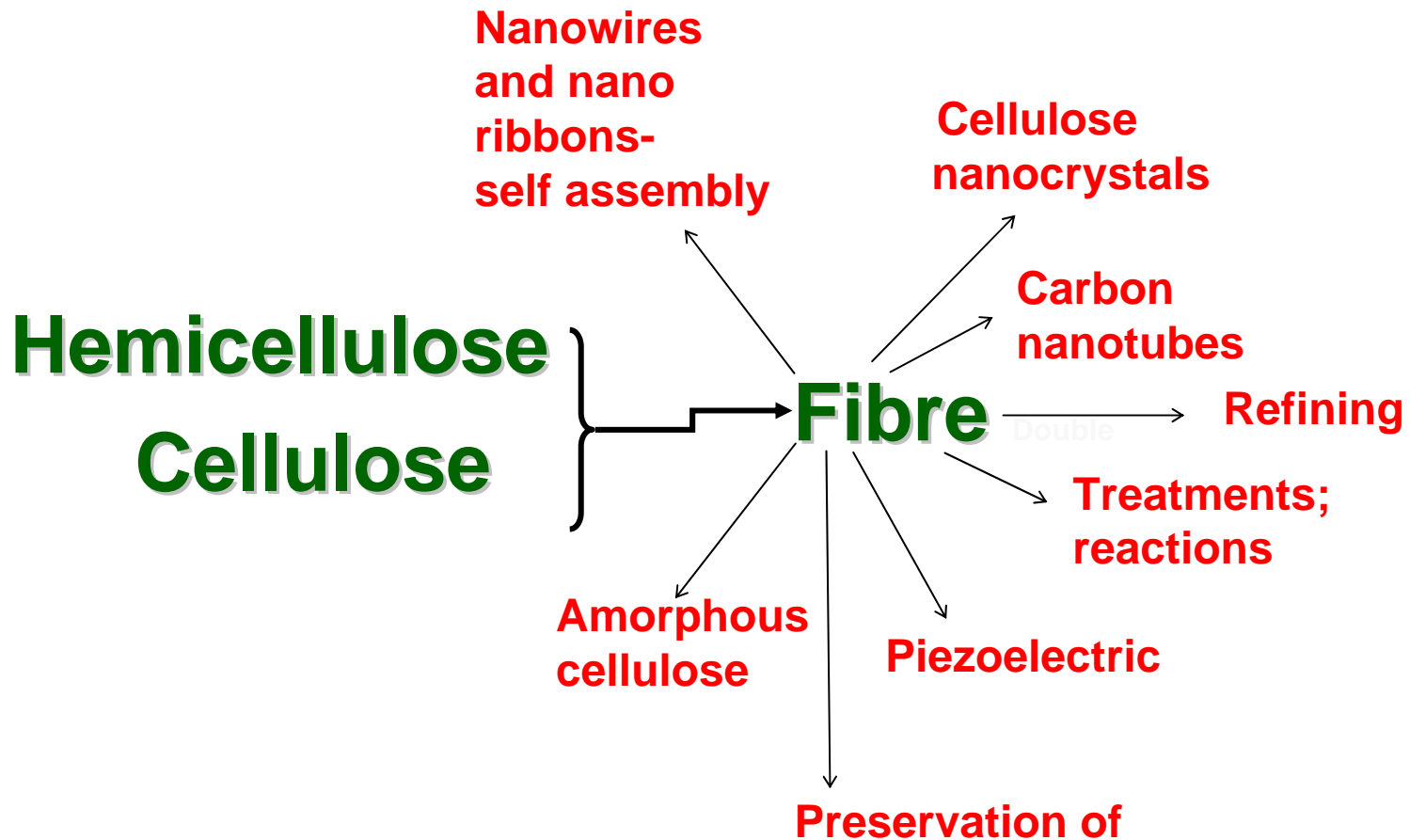


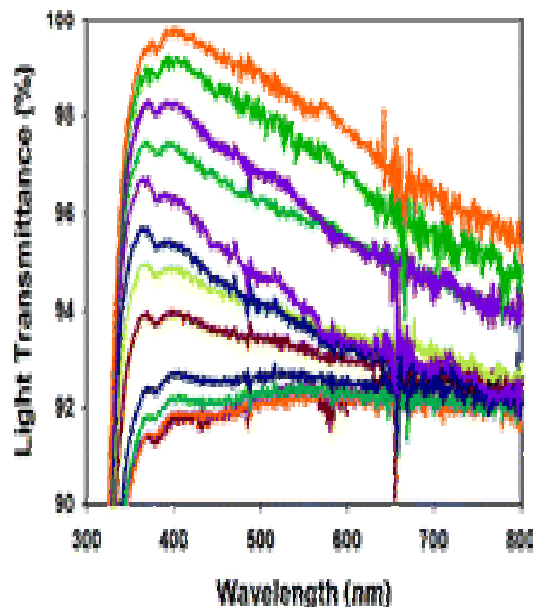
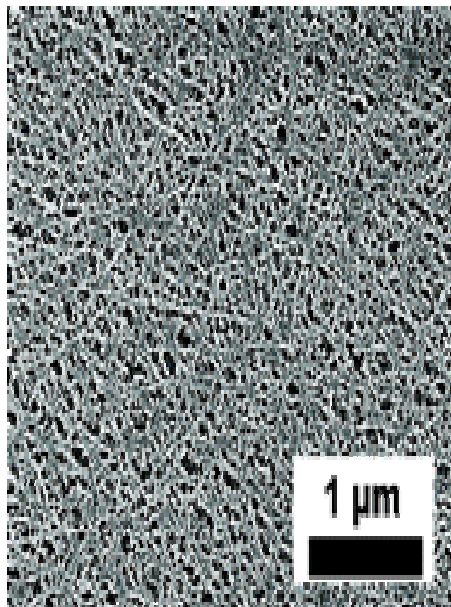
Multiple helix branching

Cellulose fiber







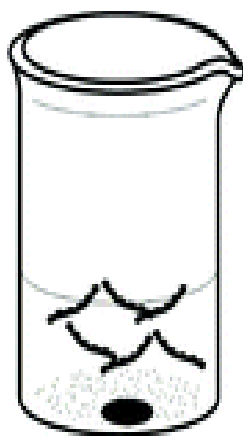


Nanocellulose wire film
Langmuir, **23** (15), 7901 -7906,
2007.

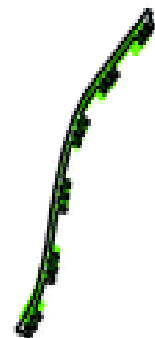
10.1021/la700772a

S0743-7463(70)00772-2

<http://pubs.acs.org/cgi-bin/abstract.cgi/langd5/2007/23/i15/abs/la700772a.html>



Removal of ionic liquid



TiO₂/cellulose composite

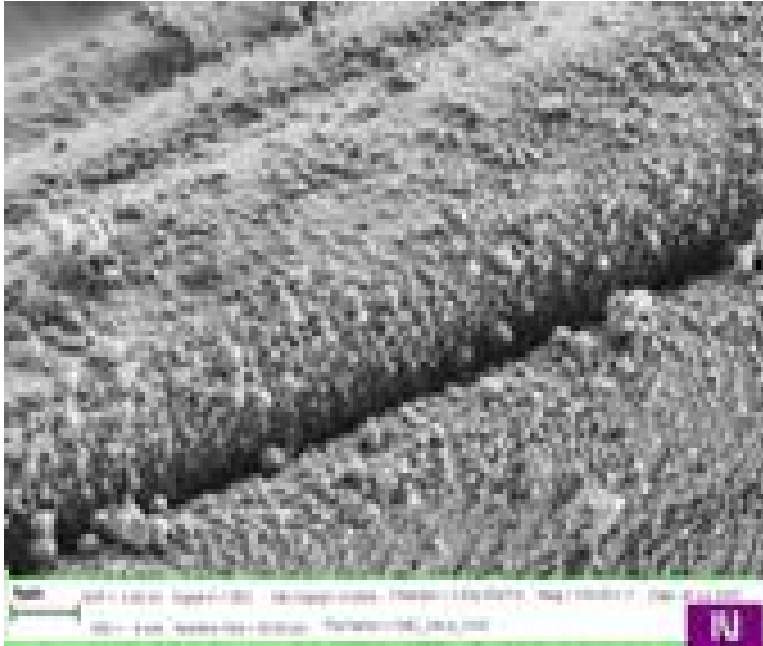
Ionic liquid +

Cellulose fibre +

Ti(OtBu)₄

Nanotitania on cellulose

<http://www.rsc.org/ejga/GC/2007/b609887h-ga.gif>



Preparation Of Nanocomposite Cellulose Fibres

***Silvo Hribernik 1, M. Sfiligoj Smole 1, K.
Stana Kleinschek 1, S. Strnad 1, M. Bele
2, V. Ribitsch 3***

*1University of Maribor, Laboratory for
Characterisation and Processing of Polymers*

2National Institute of Chemistry, Ljubljana

*3University of Graz, Institute of Chemistry,
Rheology and Colloid Science, Graz*

[http://complex.ijs.si/slonano2005/abstract_web
.htm](http://complex.ijs.si/slonano2005/abstract_web.htm)

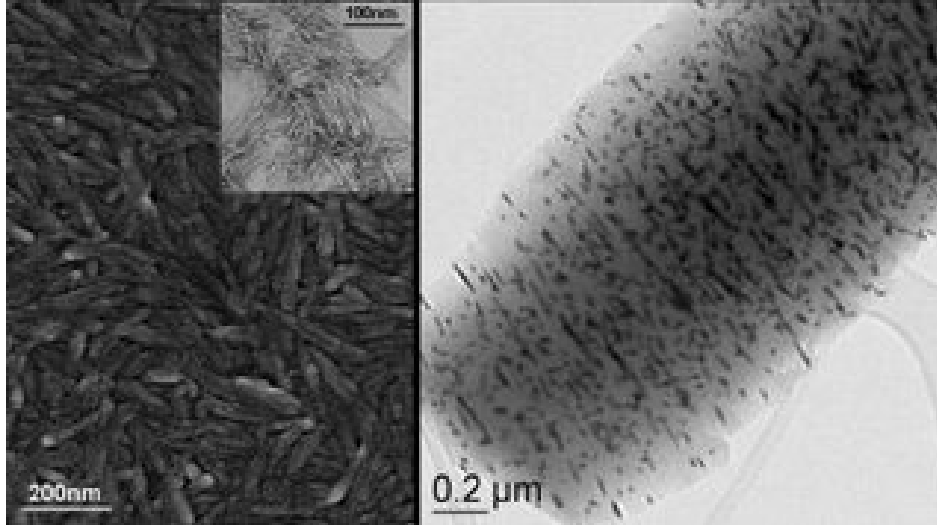


**Paper + Nanotubes = Reeeally Thin
Batteries**

Emily Gertz

August 17, 2007

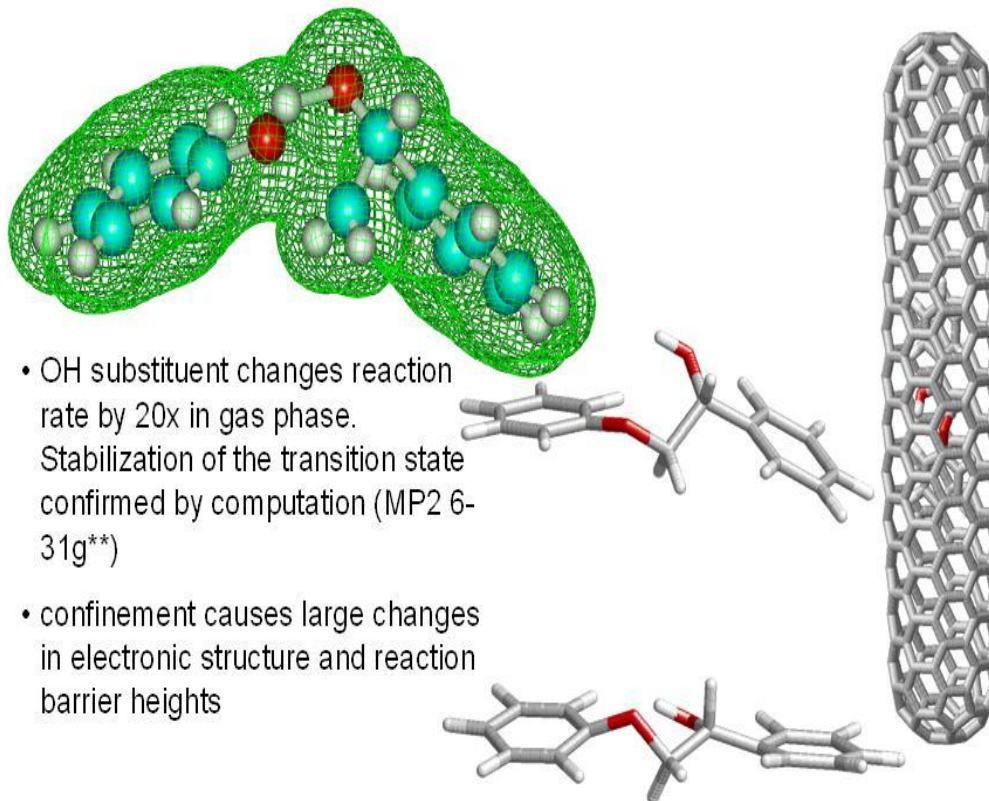
[http://www.worldchanging.com/archives/0071
30.html](http://www.worldchanging.com/archives/007130.html)



New metal crystals, formed on a cotton assembly line

Configurations of metal crystals that show promise as components in Biosensors;

<http://www.physorg.com/news94131885.html>

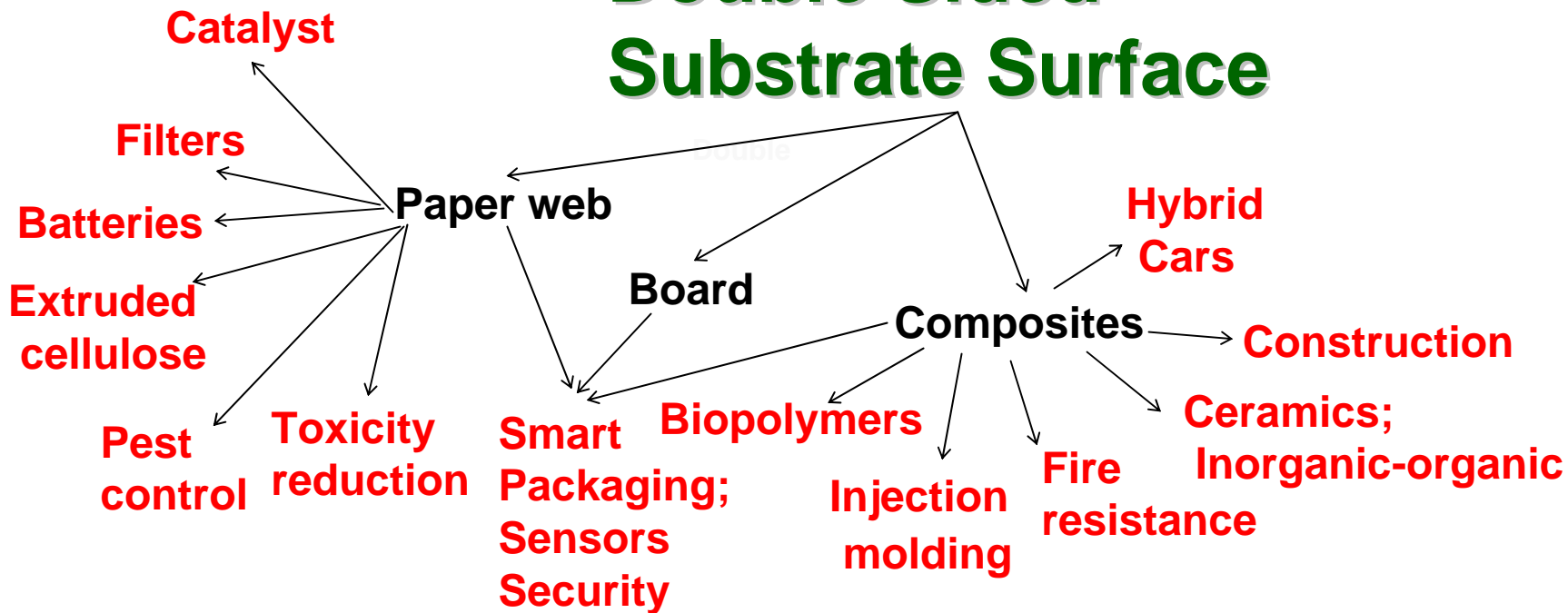


The Influence of Nano-Confinement and Hydrogen Bonding on the Transition State of Model Lignin Compounds
Bobby G. Sumpter, Phillip F. Britt, A.C. Buchanan III

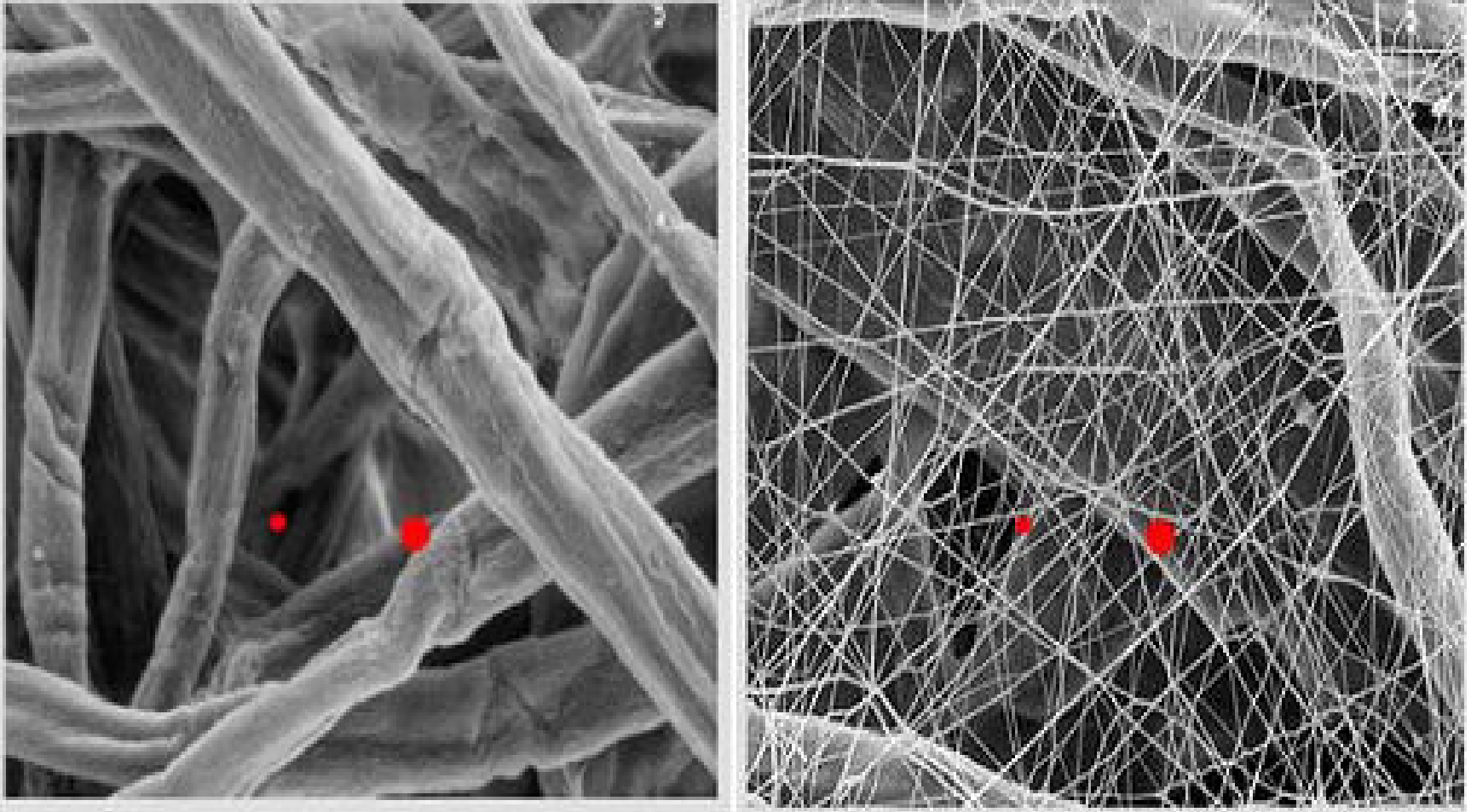
<http://www.csm.ornl.gov/ccsg/html/downloads/phenoxyhightxt.pdf>

(WO/2005/023708) LASER PYROLYSIS METHOD FOR PRODUCING CARBON NANOSPHERES

Double Sided Substrate Surface

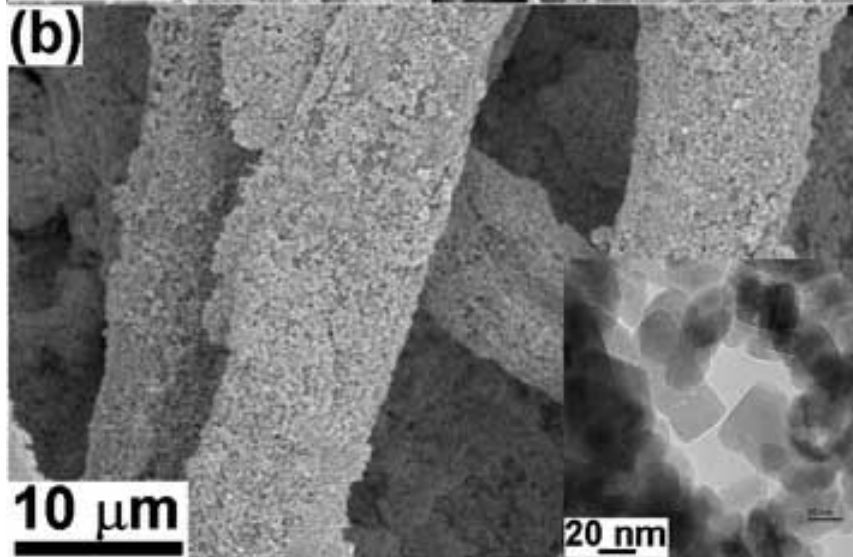
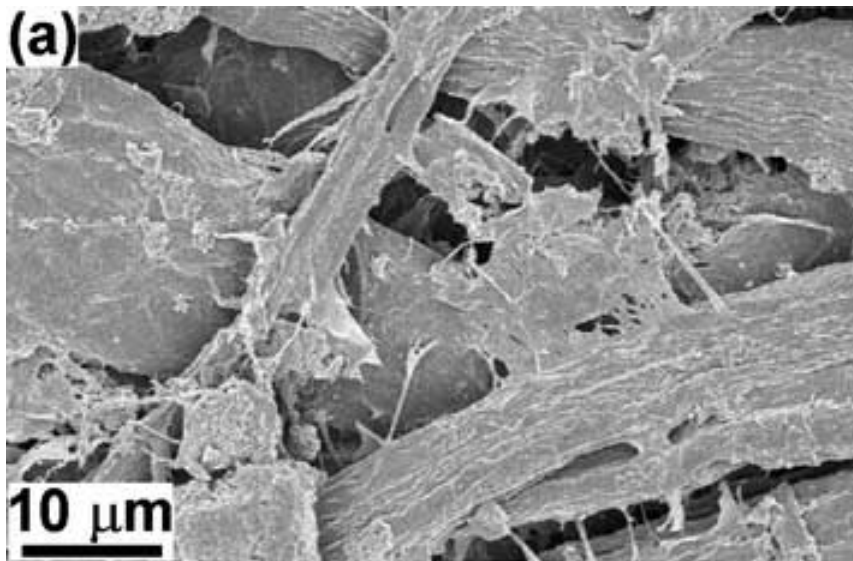


Nanofilter made with Nanocellulose



http://www.oilchief.com/logo/cellulose_nano.jpg

Anti-Toxin Coating



ZnO nanoparticles on a paper surface (thermolabile substrate) without the use of binders

Ammonia and heat treatment of ZNO and cellulose followed by Ultrasound treatment enables coating of ZnO nanoparticles

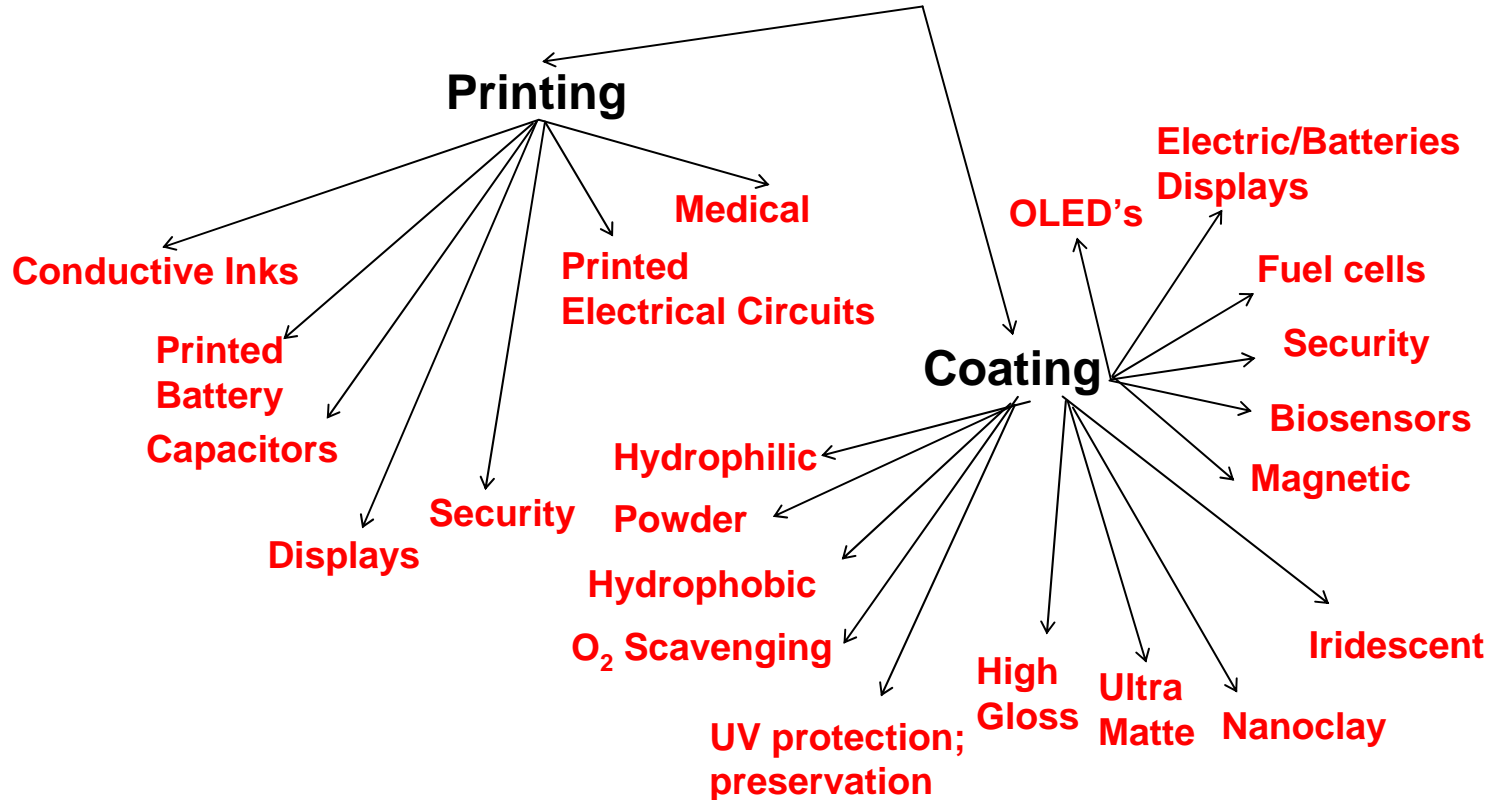
ZnO nanoparticles coated paper possesses antibacterial activity against *E. coli*.

Preparation and characterization of ZnO nanoparticles coated paper and its antibacterial activity study;

Kalyani Ghule, Anil Vithal Ghule, Bo-Jung Chen and Yong-Chien Ling
Green Chem., 2006, **8**, 1034 - 1041, DOI: 10.1039/b605623g

<http://www.rsc.org/publishing/journals/GC/article.asp?doi=b605623g>

Modified Surface



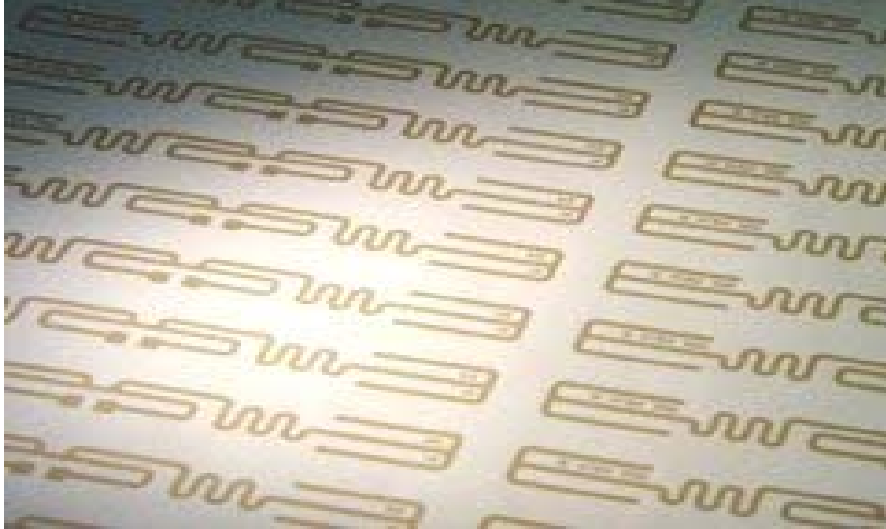
New Nano Silver Powder Enables Flexible Printed Circuits

http://www.nanoproducts.de/index.php?mp=products&file=info&language=eng&products_id=95

Silver kills odor-causing bacteria and neutralizes ammonia

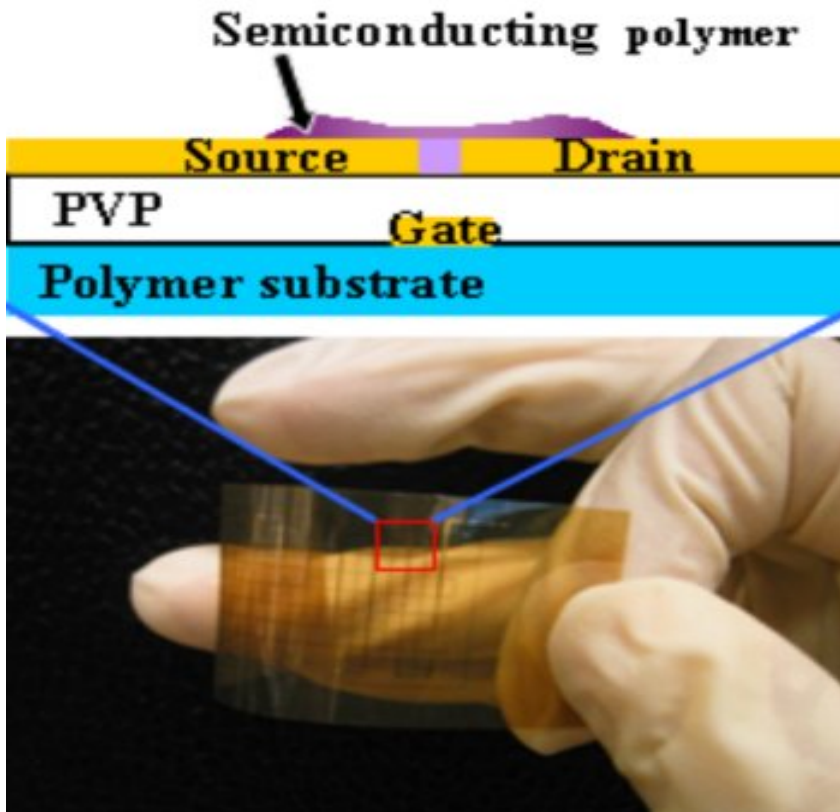
Antimicrobial coated textiles for performance apparel, infection-resistant medical devices, and glazes for sanitary ware that permanently inhibit odors and stains without chemical cleaners.





RFID antennae technology
manufactured with Parelec's
Parmod® conductive inks

<http://www.parelec.com/>

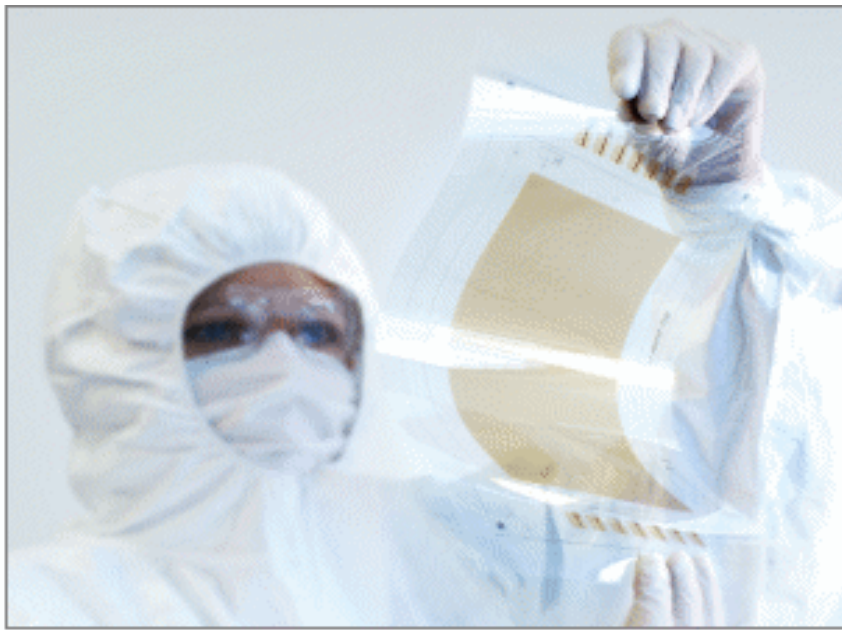


Low-voltage inkjetted organic transistors for printed RFID and display applications

Steven E. Molesa, Alejandro de la Fuente
Vornbrock, Paul C. Chang, and Vivek
Subramanian

Uses Hexanol ink jet solvent with cross
linkable [polyvinylpyrrolidone](#) coating

<http://organics.eecs.berkeley.edu/pdf/IEDM05.pdf>



Nanoident Technologies has delivered the world's largest printed semiconductor-based photo detector array on a flexible PET foil substrate

http://www.cintelliq.com/docs/OSAD20070521_sample.htm

<http://www.nanoident.com/technology/production-process-in-depth.html>



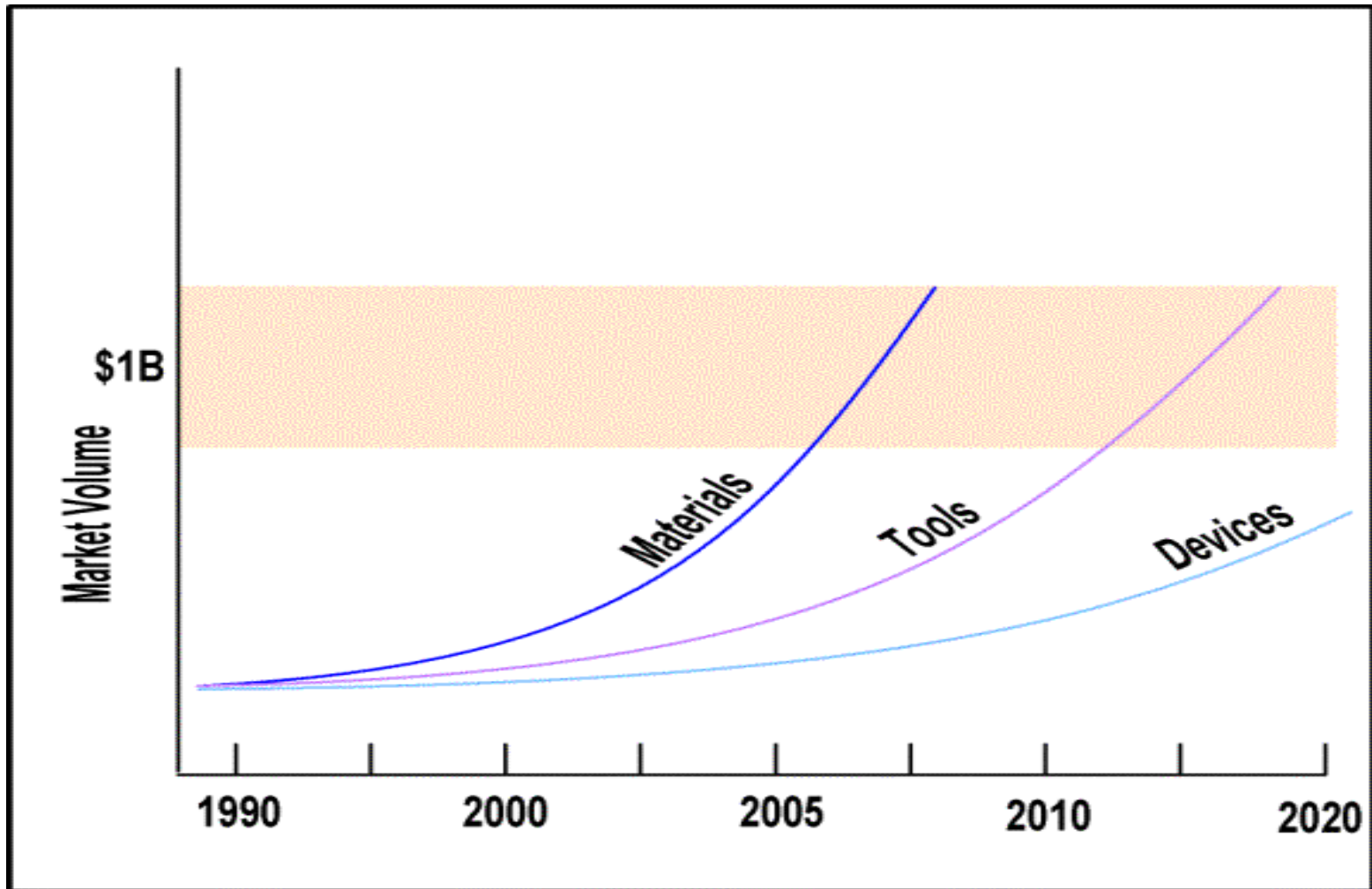
Paper printed with polymer channels

<http://www.nature.com/doi/10.1038/445342a>

Defense applications

- On site fuel production
- Light weight body armor
- Temporary shelter
 - IR resistant shelter
 - Light weight shelter
 - Recyclable shelter

Nanotechnology value



<http://www.nanomaterialscompany.com/images/Nanomaterials-growth-graph.gif>

Conclusions

- There are a variety of potential applications in the forest products sector where Nanotechnology can be applied to provide unique products.