



A NANOTECHNOLOGY ROADMAP FOR THE FOREST PRODUCTS INDUSTRY

NANOFORREST

SIXTH FRAMEWORK PROGRAMME

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NANOTECHNOLOGY

Nanotechnologies are the **design,
characterization, production and
application of structures, devices and
systems **by controlling shape and size
at nanometre scale.****

**The Royal Society and
The Royal Academy of
Engineering (2004)**



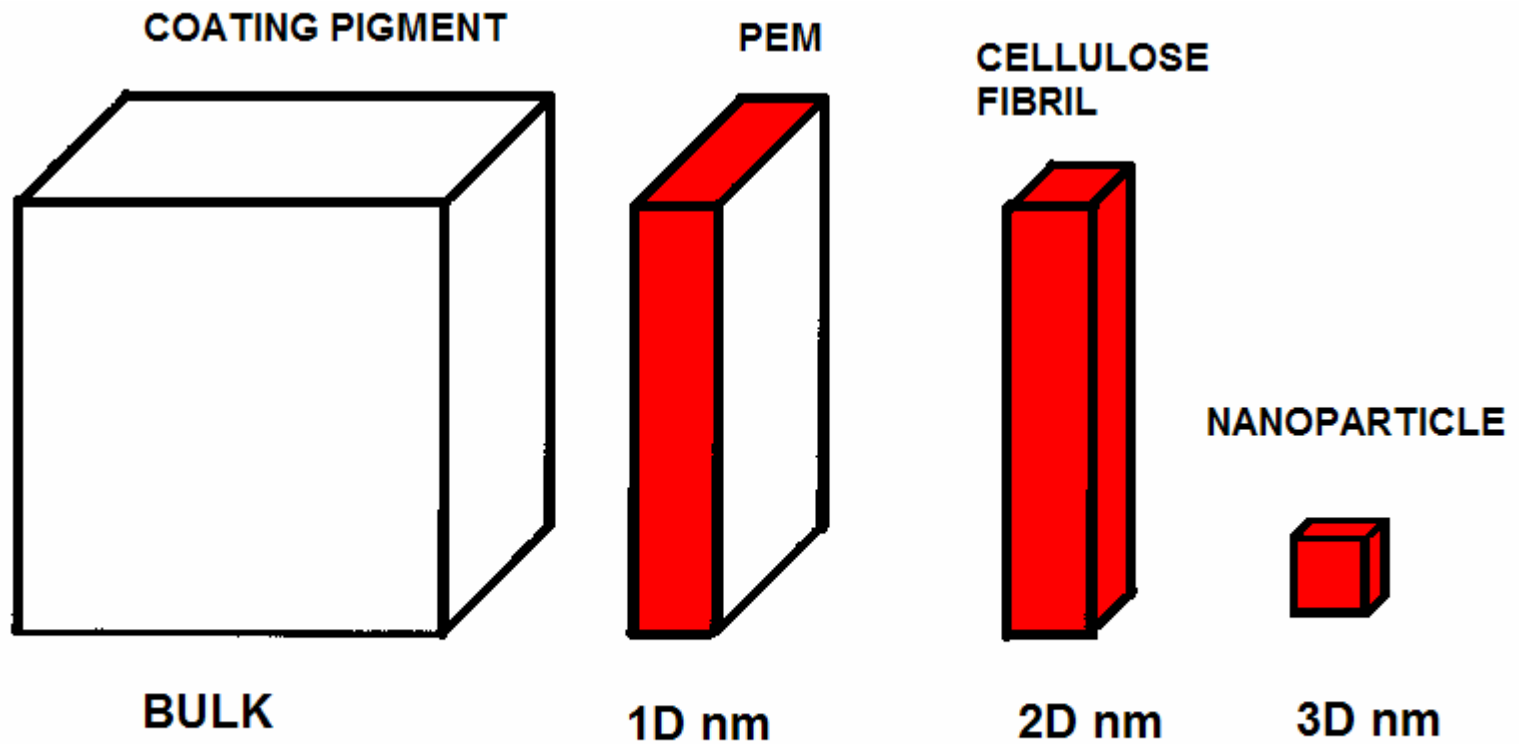
NANOSCALE / NANOMATERIALS

The small size, 1 to 100 nm, of nanostructures leads to an exceptionally large interfacial area

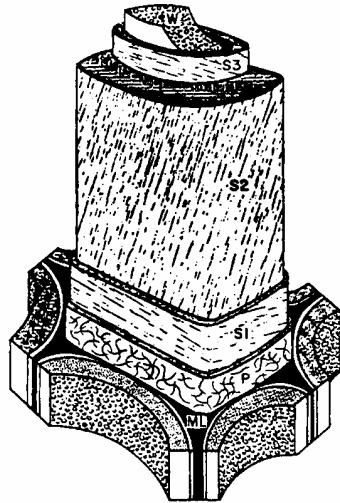
The properties of the interfacial region differ from those of the bulk

It is possible that new physics or chemistry *may* occur

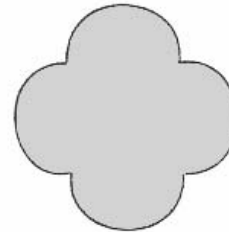
NANOSTRUCTURES



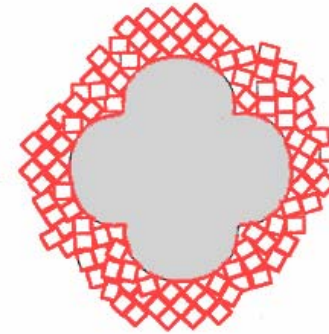
Why Forest Products? – Silica (SiO_2) nano-casting



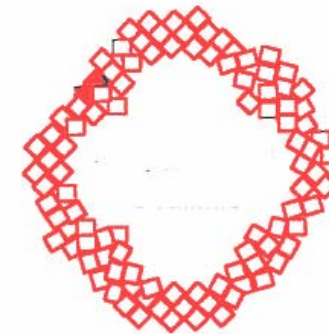
Silica sol-gel



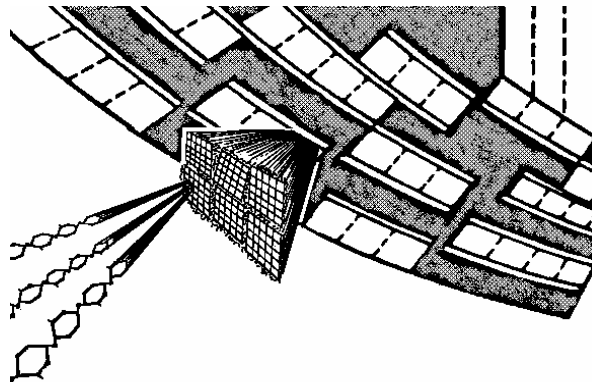
Wood fibre component (template)



Burn off organic material



Nano-cast that mimics the size and shape of the template



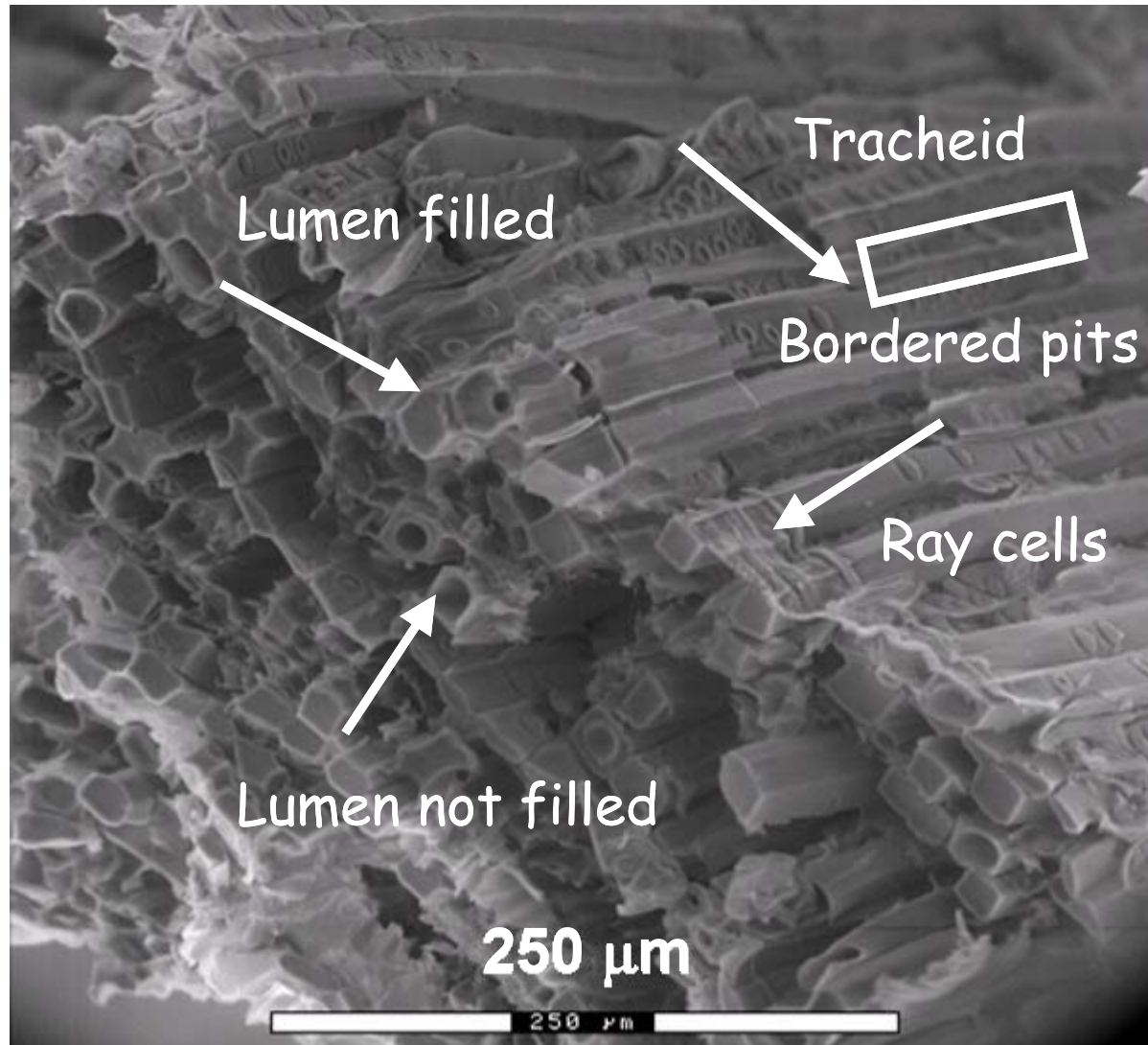
Silica Nanocasting Spruce Wood



After impregnation

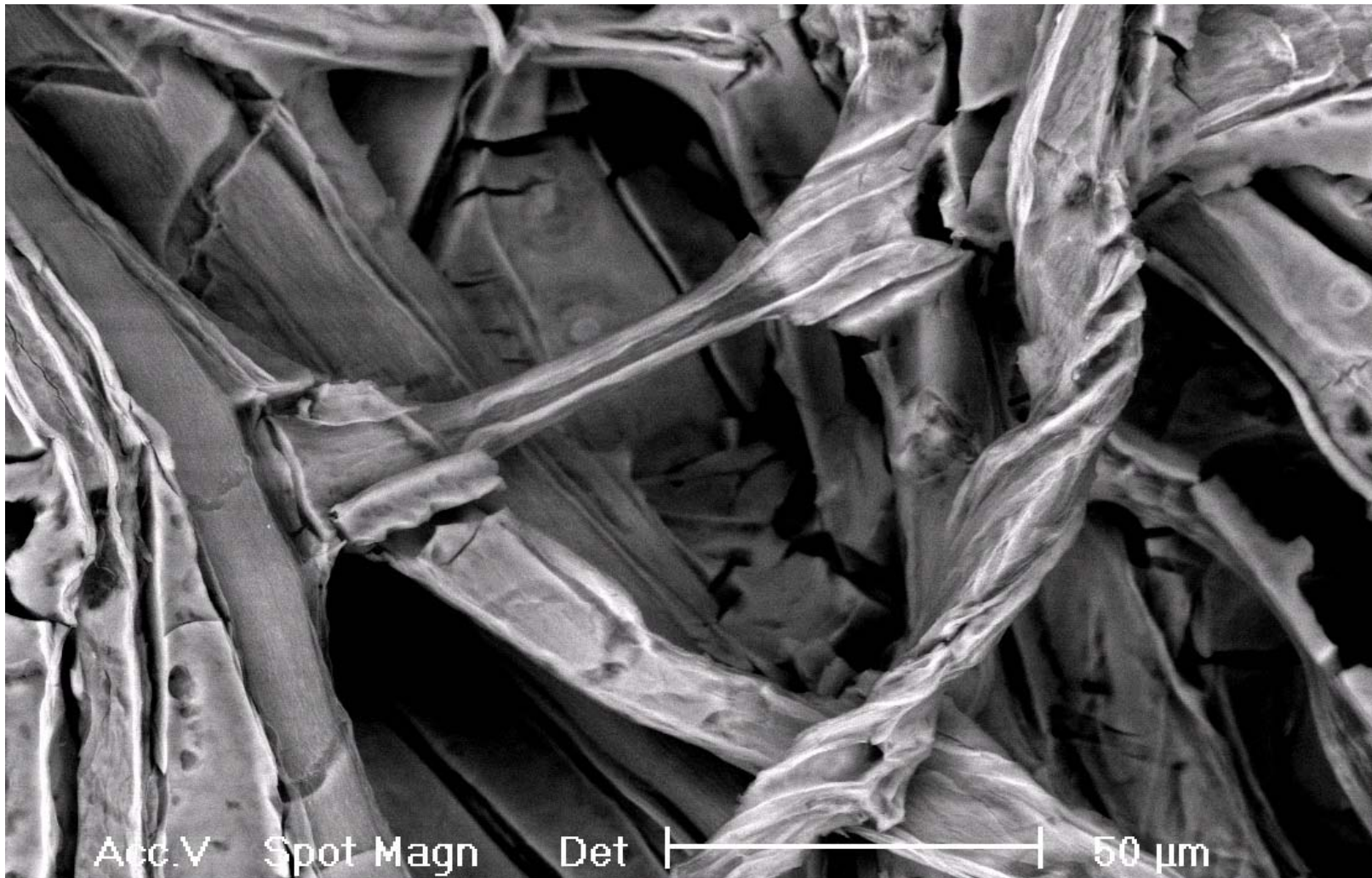


Spruce wood – SiO_2 after calcination (ESEM)





Paper – SiO₂ after calcination (ESEM)

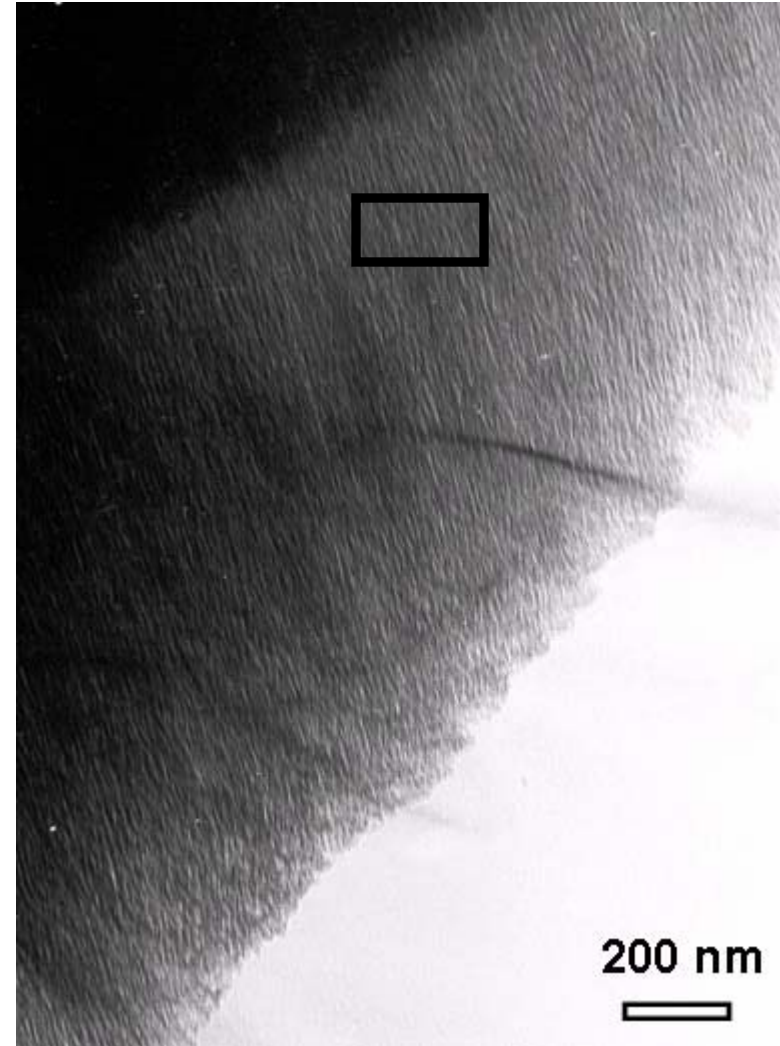


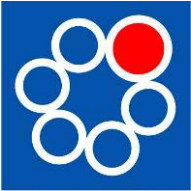
Wood



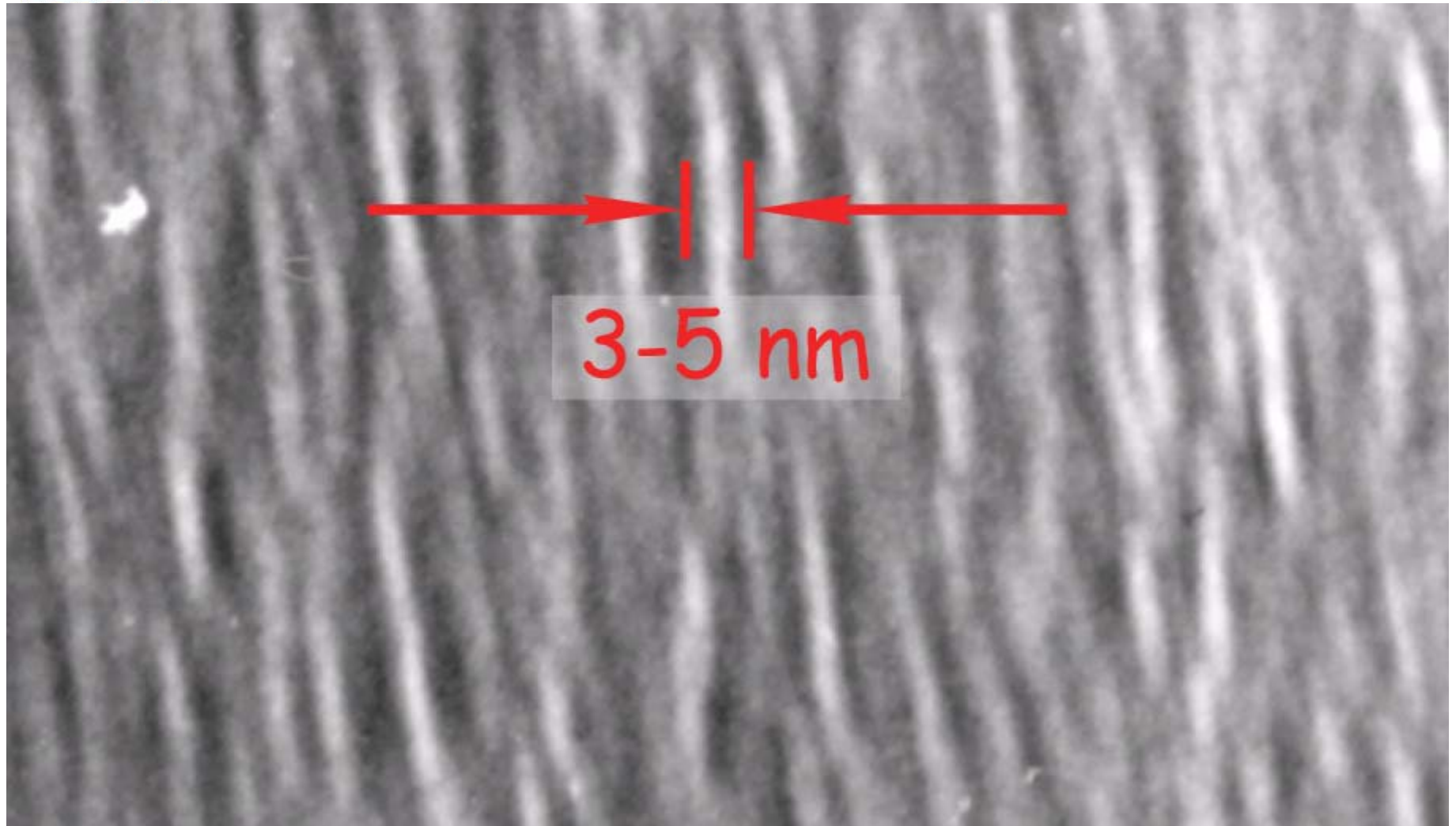
Spruce secondary wall (TEM)

Kraft pulp kappa 18





Kraft pulp kappa number 18



Spruce secondary wall (TEM)



Wood and Pulp Fibres: Hierchically Structured Biological Nanomaterials

Nanometer level

- Cellulose fibrils
- Fibril aggregates
- Cell wall pore system



NANOFOREST - OBJECTIVE

To recognize new and emerging developments in nanotechnology and related areas suitable for **practical implementation** in the forest products sector



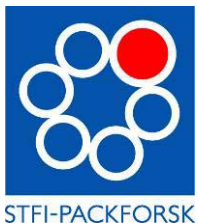
NANOFOREST - VISION

The successful introduction and application of nanotechnology in the refinement of forest-based raw materials will allow the production of **new generations of innovative and high value-added materials.**

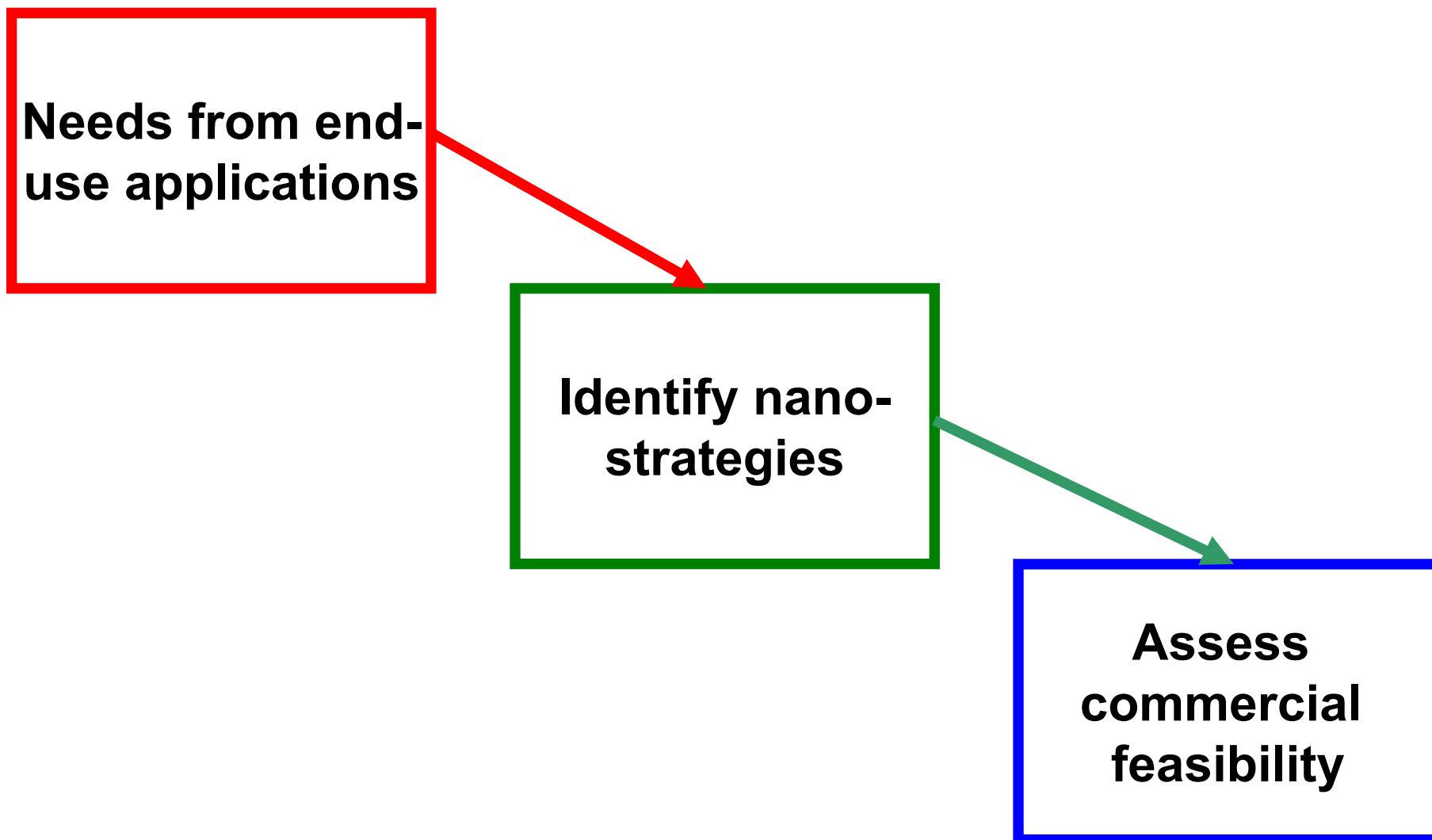


EXPERTS

- **STFI-Packforsk:** Dr. Tommy Iversen, Dr. Tomas Larsson, Dr. Mikael Lindström. Prof. Tom Lindström
- **SP Träteknik:** Dr. Jan Ekstedt, Dr. Birgit Östman
- **KTH:** Prof. Lars Berglund, Prof. Lars Wågberg
- **HUT:** Prof. Janne Laine, Dr. Monika Österberg



ROADMAP STRUCTURE





MAJOR TOPICS

1. **Analytical Tools**
2. **Wood and wood products**
3. **Pulp, papermaking and packaging**
4. **New materials and composites**
5. **Education and training**
6. **Environment, safety and health**



SCOPE OF ROADMAP

- **Challenges**
- **Nanotechnology opportunities**
- **Barriers for nanotechnology**
- **Priority research need**
 1. **Short-term items (0-3 years)**
 2. **Mid-term items (by 2010)**
 3. **Long-term items (by 2020)**

RECOMMENDATIONS

With focus on **near-future** the following recommendations for research and development areas have been judged most relevant

- **Wood and pulp fibre cell wall nanostructure**
- **Industrial utilization of cellulose (nano)fibrils (MFC)**
- **Surface treatments for fibres and cellulose (nano)fibrils**



FUTURE

A **paradigm shift** from mass produced single-use fibre products to **new concepts** of tailored biocomposite materials

www.stfi-packforsk.se