Pajun uudet käyttömahdollisuudet – VTT – Aalto -yhteistyöprojekti

Pajun kestävä tuotanto ja käyttö -seminaari,
Jyväskylä 28.1.2015

Ulla Holopainen-Mantila
Teknologian tutkimuskeskus VTT Oy

Background

Aalto University
School of Chemical Technology

- Global demand to produce biorenewable chemicals and fuels from non-food plant sources
- Cellulose in plant biomass can be conversed to ethanol using advanced enzyme technology. However, also other components present in large quantities (such as lignin) should be utilised efficiently

- **Why willow (*Salix* sp.)?**
  - fast growth
  - ability to grow on lands not optimal for forest or agricultural use
  - use in purification of runoff water
  - several species and hybrids can be grown in Finland

The outcome of the project will be …

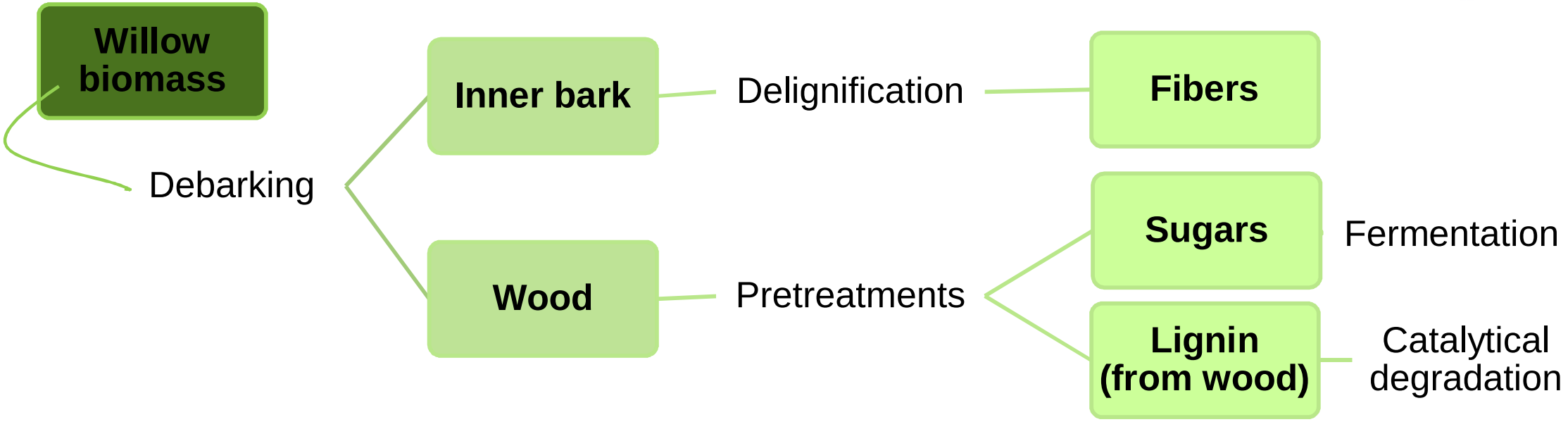
Aalto University
School of Chemical Technology

- A concept for the complete valorisation of willow biomass
  - **bark** fraction will be used for production of fibers
  - **wood** fraction will be hydrolyzed for sugars
  - **lignin** residue will be depolymerized for aromatics

- The products obtained are expected to be of higher quality than references from traditional raw materials

- Effective utilization of willow biomass would benefit
  - Forest owners (more efficient use of land)
  - Pulp produces (high quality fibers for special applications)
  - Sugar/bioethanol producers (novel source of lignocellulosic sugar)
  - Fuel and chemical manufacturers (sustainable source of green aromatics).

Deconstruction flow



- Starting material, process intermediates and products are characterized by various analytical methods including
  - Basic compositional analyses
  - Advanced chemical methods (e.g. NMR, LC-MS, GC-MS, HPLC, GPC)
  - Microscopy (stereo-, light, confocal and electron microscopy)
  - Raman spectroscopy

Controlled deconstruction of willow biomass (CODE Willow)

Aalto University
School of Chemical Technology

- Aalto - VTT –cooperation project (‘Forest meets chemistry’ call)
- Duration: **1.8.2014 - 31.12.2015**

- Research partners
  - **Principal Scientist Tarja Tamminen (VTT Oy)**
  - **Prof. Kristiina Kruus (VTT Oy)**
  - **Principal Scientist Arvo Leinonen (VTT Oy)**
  - **Prof. Tapani Vuorinen (Aalto,** *Department of Forest Products Technology***)**
  - **Prof. Ari Koskinen (Aalto,** *Department of Chemistry/Organic Chemistry***)**

Willow material

Aalto University
School of Chemical Technology

- Willow material in this project has been collected near Jyväskylä under supervision of Arvo Leinonen (VTT Oy)

- **Dark-leaved willow (*Salix myrsinifolia*)** (mustuvapaju)
- ***Salix schwerinii*** (siperianpaju)
- **Hybrid willow ’Karin’**
- **Hybrid willow ‘Klara’**

Raw material (hybrid ‘Karin’)

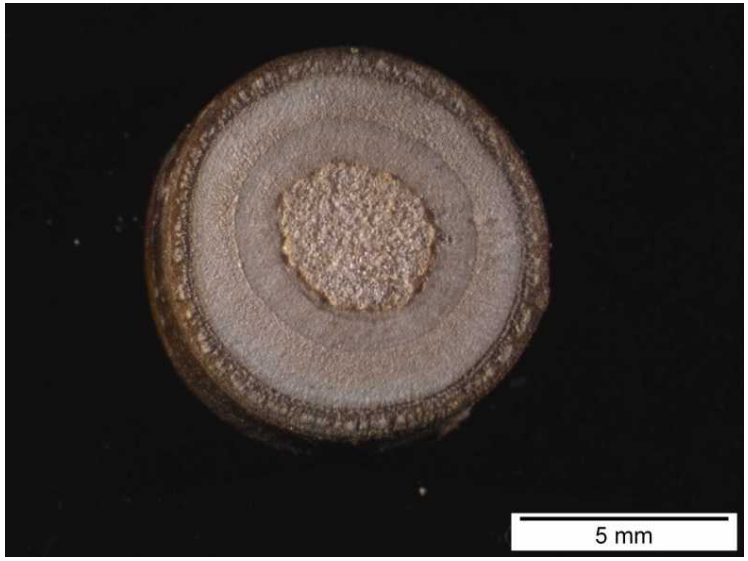
Willow species and hybrids (2 years old)

Dark-leaved willow

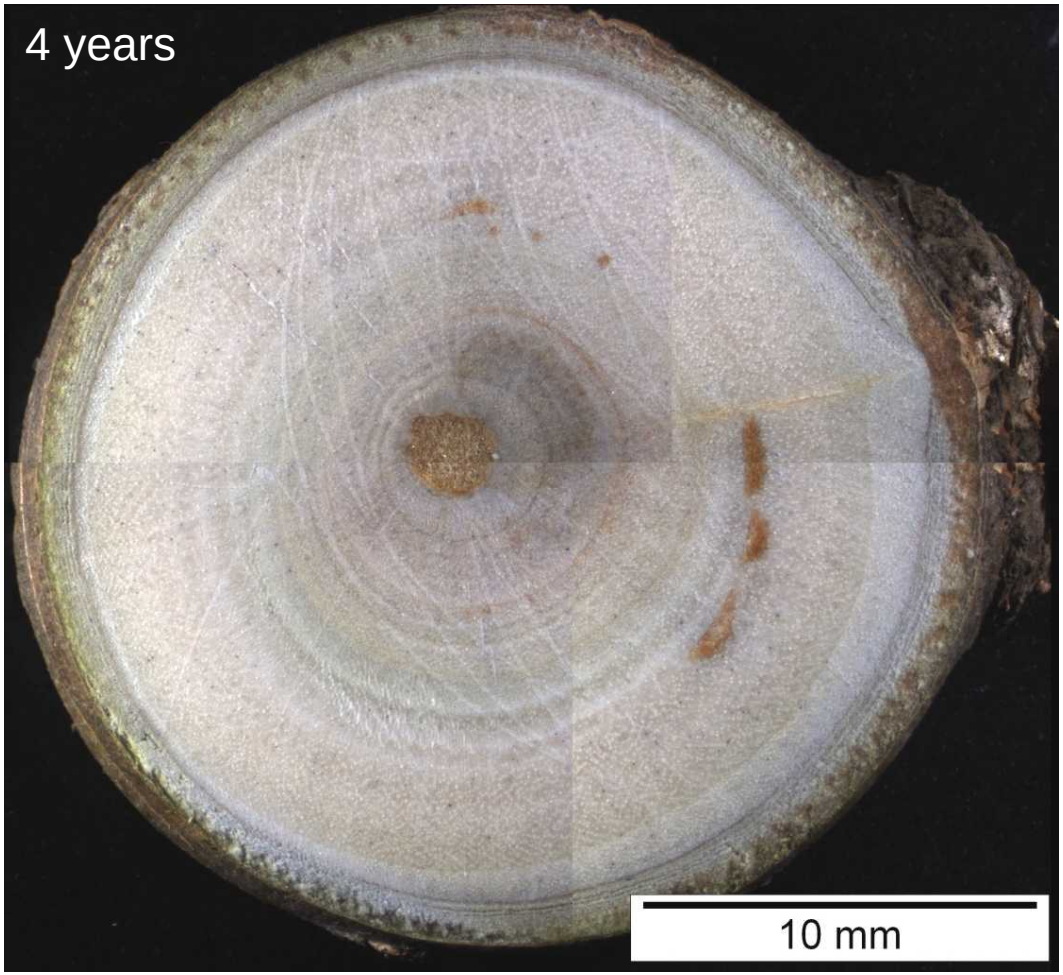
Hybrid willow ’Karin’

Hybrid willow ‘Klara’

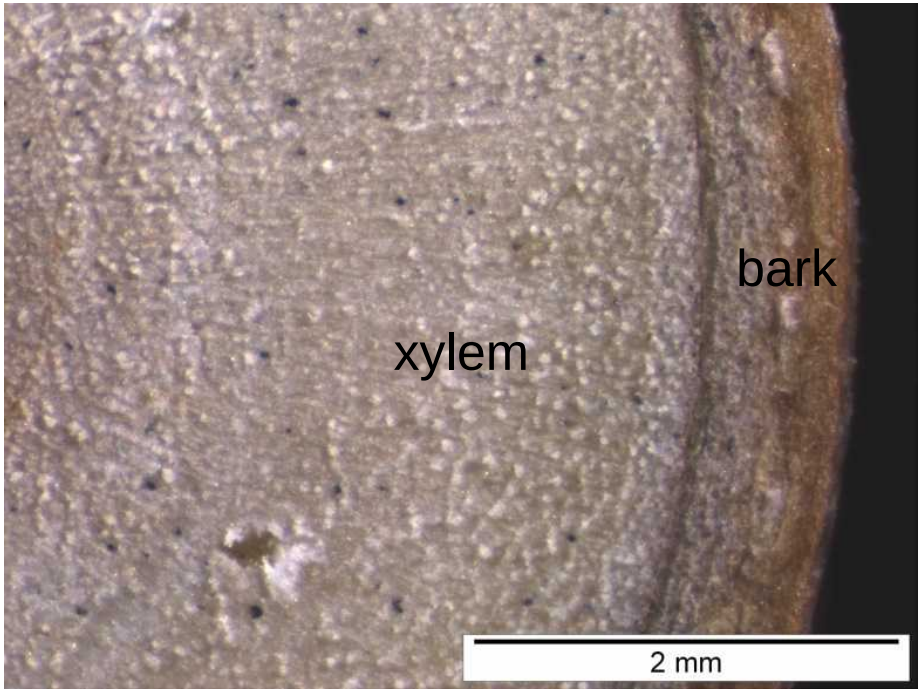
Salix schwerinii

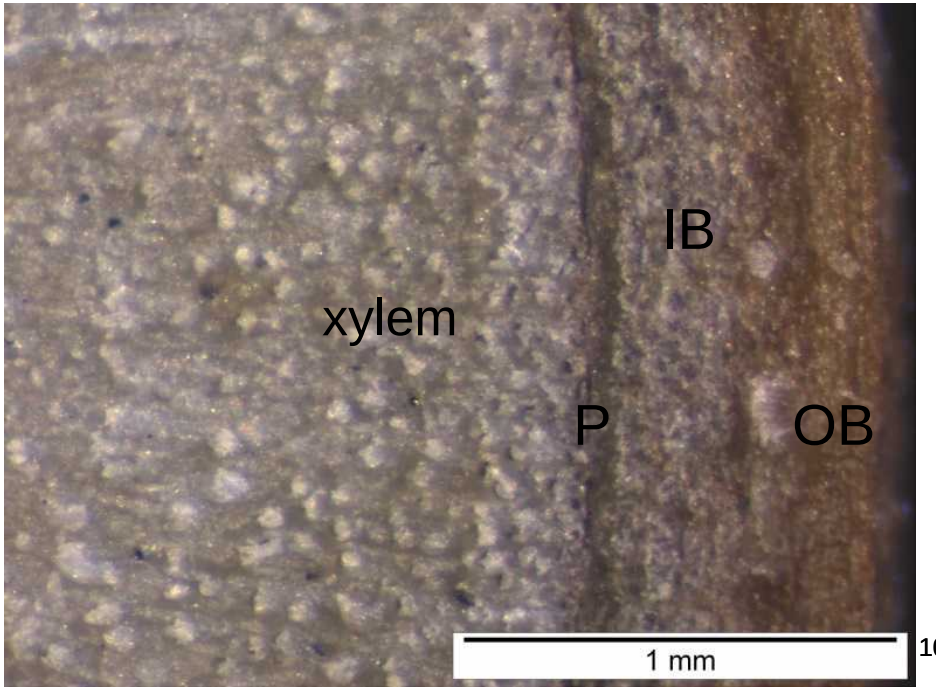


Aging of hybrid ‘Karin’



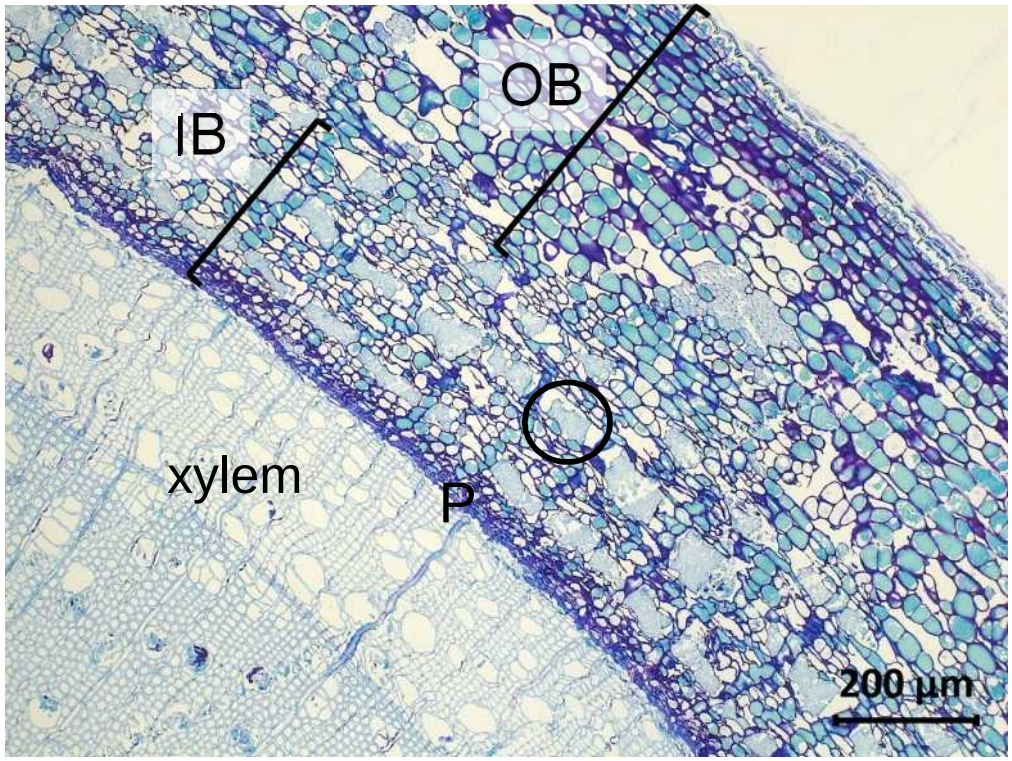
Structure of willow wood cross section

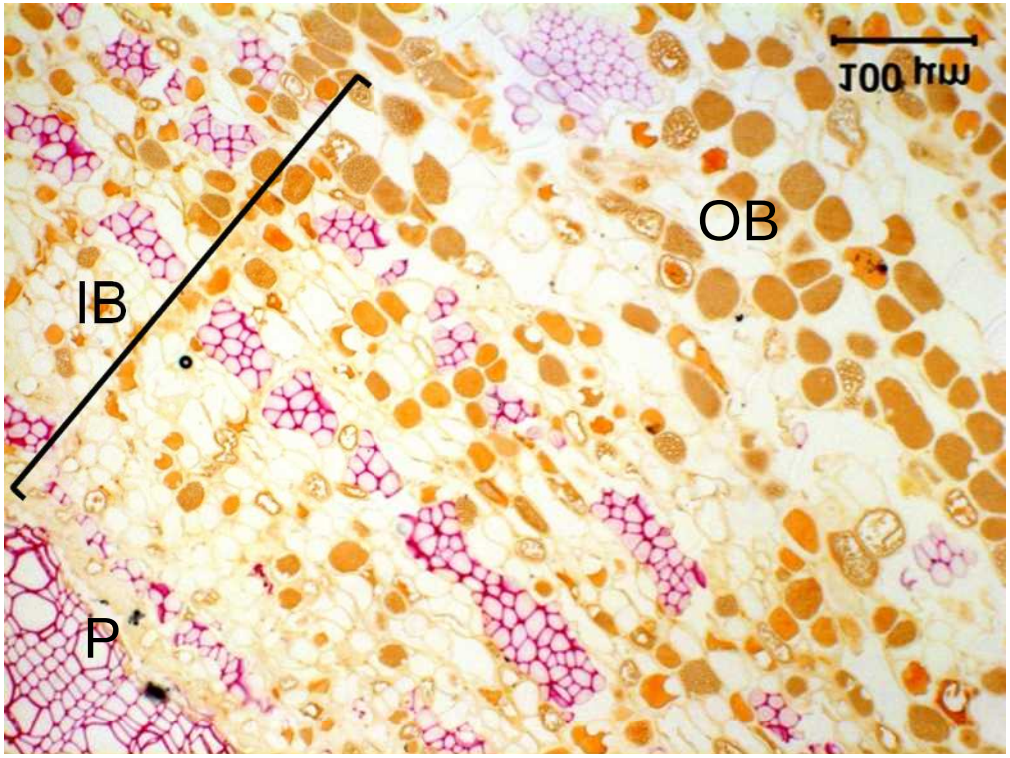


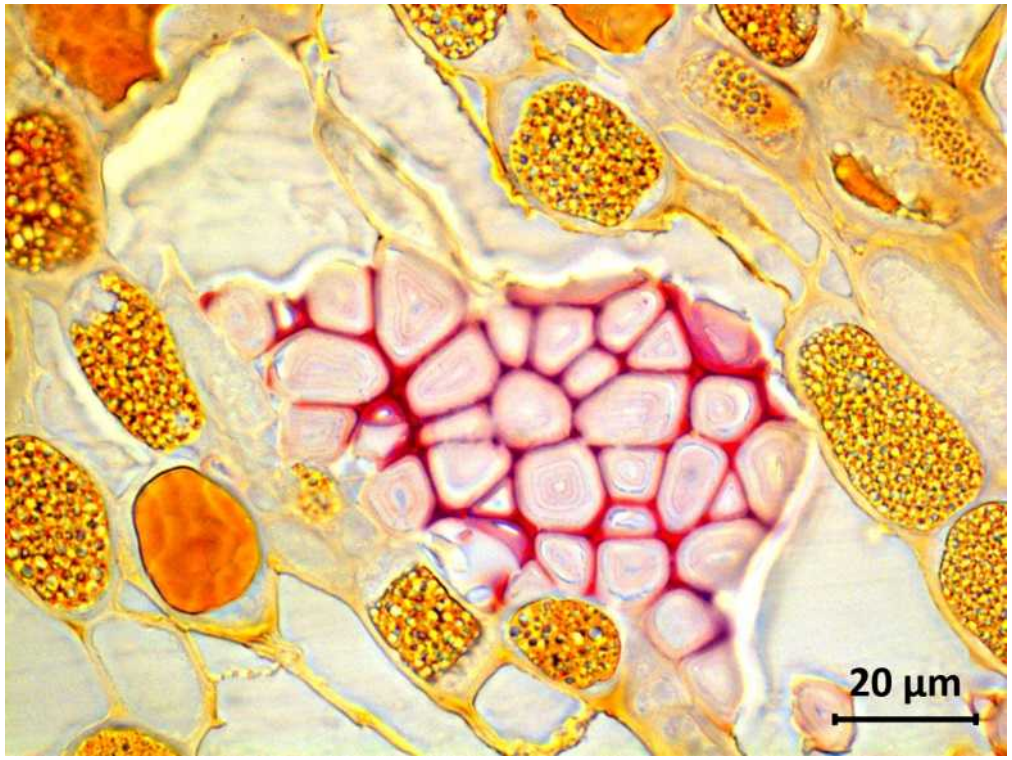


Inner bark contains fibre bundles

- Three-years old bark contains three rows of fibre bundles

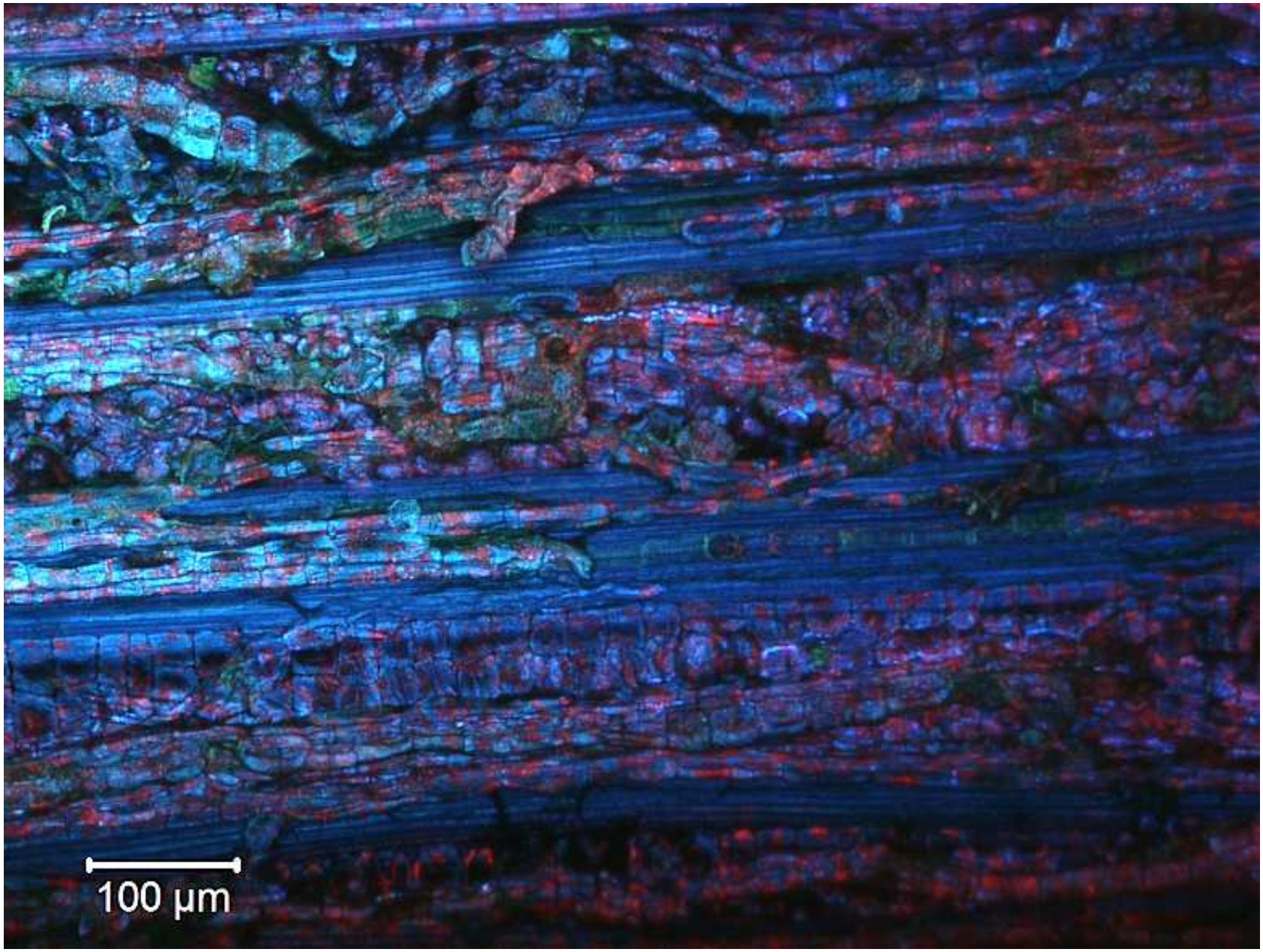




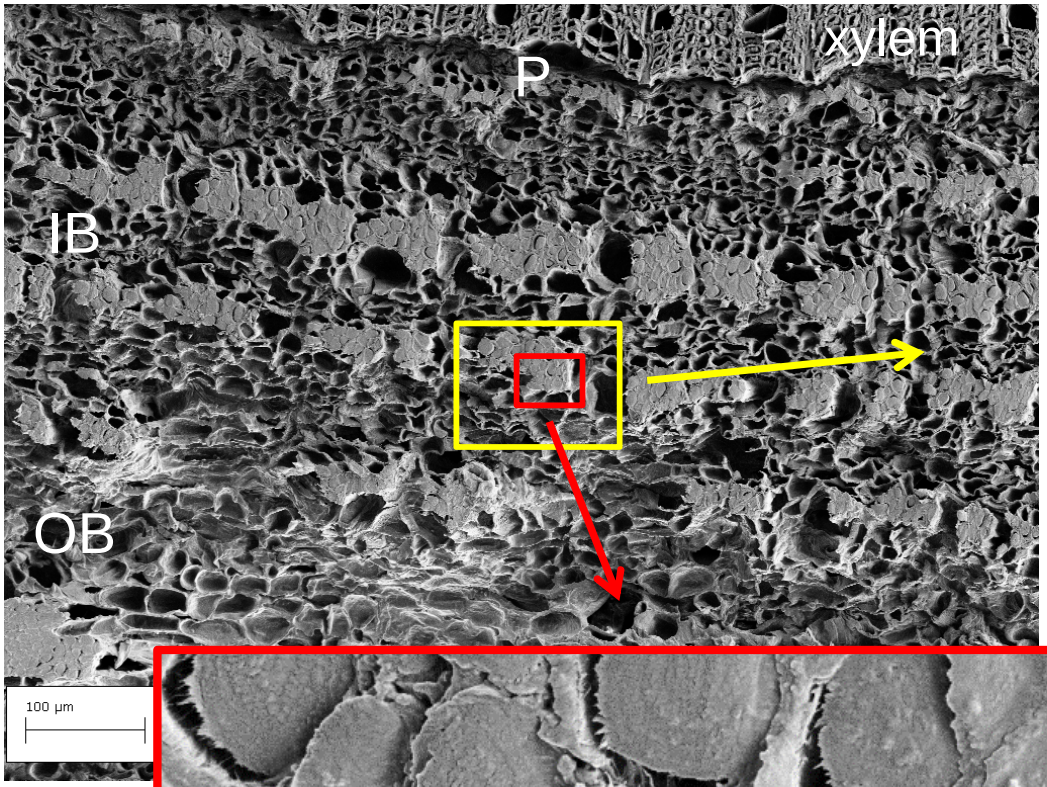


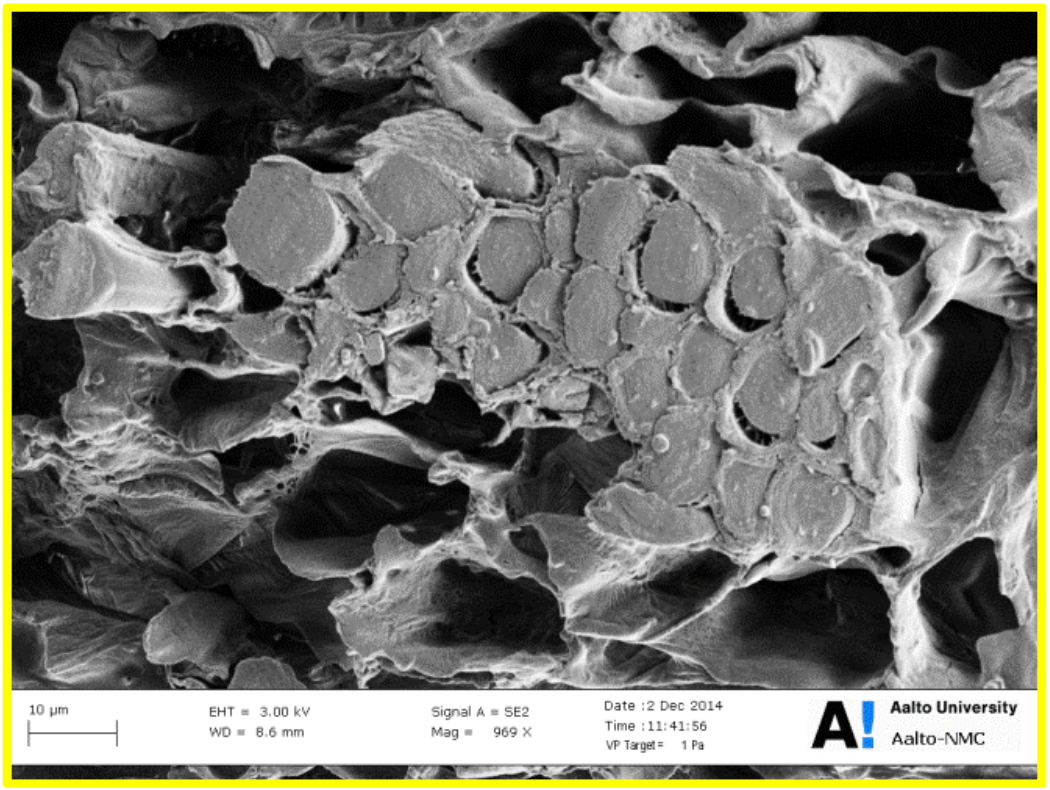
Longitudinal view of inner bark fibres

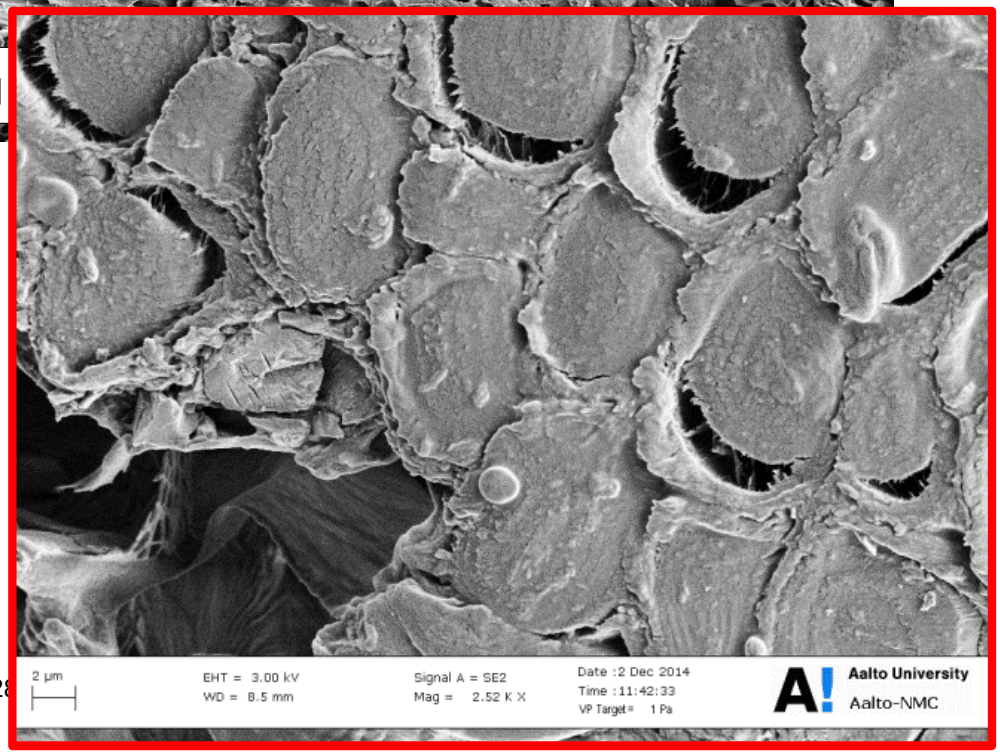
- Fibre bundles imaged by confocal laser scanning microscope



Structure of inner bark fiber bundles







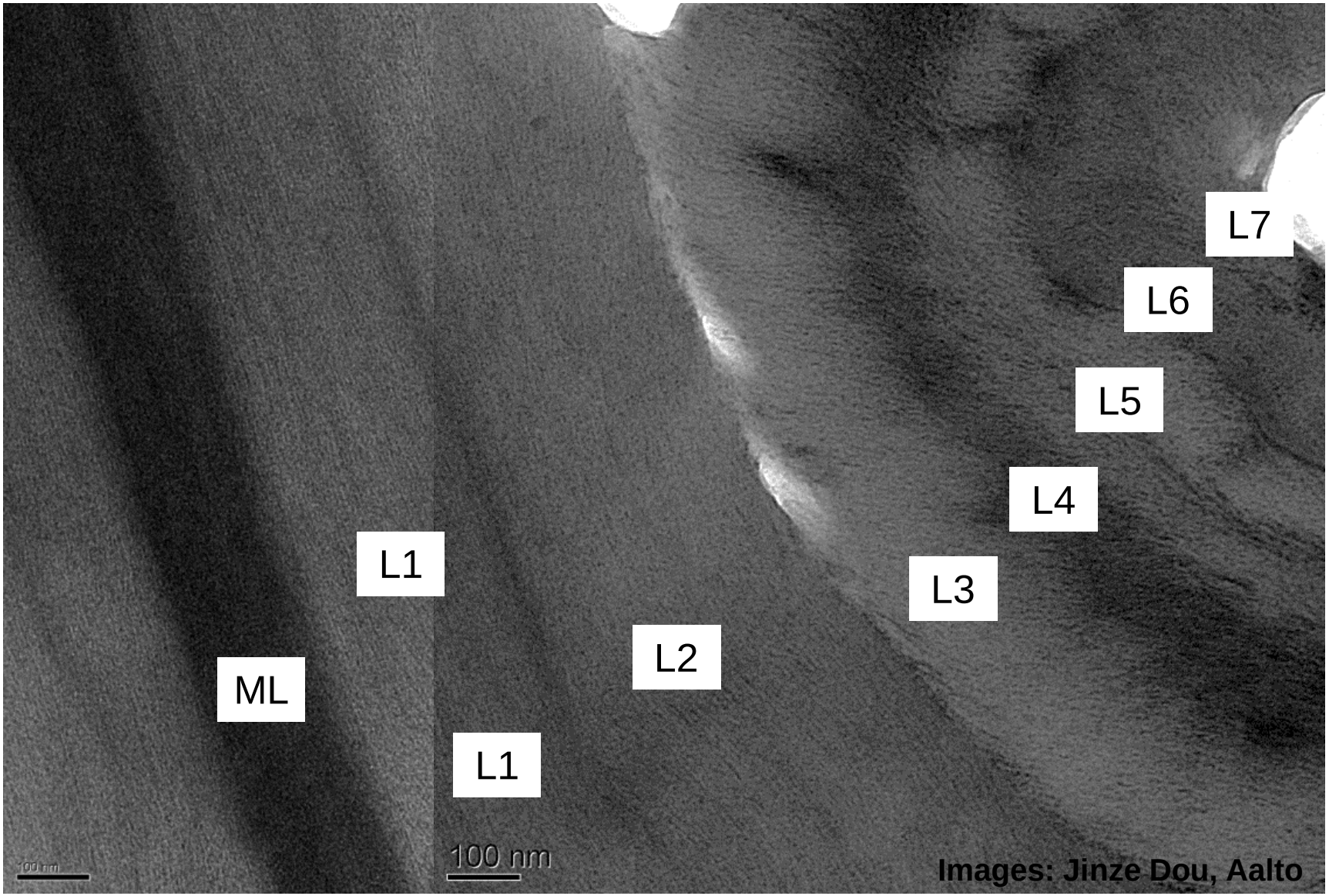
- Images taken by scanning electron microscope

Images: Jinze Dou, Aalto

Aalto University
School of Chemical Technology

Layered structure of inner bark fiber bundles

- Imaged by transmission electron microscope



Images: Jinze Dou, Aalto

Aalto University
School of Chemical Technology

Conclusions and continuation of the project

Aalto University
School of Chemical Technology

- Morphology of inner bark fibre bundles shows characteristics that are likely to influence their processing behaviour
- Chemical analyses of inner bark fibres as well as other fractions and process intermediates will further reveal the applicability of willow fractions for different purposes
- During year 2015, project will produce extensive data set that can be utilised in the development of novel, willow-based processes and products

Aalto University
School of Chemical
Technology