

# Characterisation

## Newsletter

Number 10, August 2011

### News from PFI

**Industrial-scale production of MFC.** MFC from cellulose pulp have been produced on an industrial scale at a level of 1.5 tonnes a day. The research and industrial scale trials have been performed by scientists from the Paper and Fibre Research Institute (PFI) in Norway together with colleagues from Södra Cell, Norske Skog and SPX Flow Technology. [Read more...](#)

#### New research scientist

Mihaela Tanase Opedal has joined PFI's group Fibre and pulp, and will work with various projects in this area. She completed her PhD at NTNU, Trondheim, in March 2011 as part of the [E2POX-project](#) at PFI.

#### New Post doc

Florina Laura Alexandrescu has joined PFI's Paper and novel materials group, working in the [Nanofilter project](#).

### Surface modification

[Microfibrillated cellulose \(MFC\)](#) has gained much attention during the last years. MFC is a fibrillated cellulosic material, which is composed of a major fraction of [cellulose nanofibrils](#). PFI research has demonstrated that MFC can be utilized as *e.g.* strength enhancer in paper, for stabilizing oil-emulsions and within packaging applications. In addition, PFI has recently conducted an [industrial-scale trial for production of MFC](#), which is a significant step forward in this research area. Cellulose nanofibrils are hydrophilic, which is a good advantage for forming interfibrillar hydrogen bonds and, hence, strong nanopaper structures. However, in some applications the hydrophilic nature of nanofibrils needs to be modified. This may be the case in composite applications, where a good compatibility between the reinforcing nanofibrils and surrounding hydrophobic matrices is necessary. In addition, barrier against water is a requirement for various [packaging](#) applications. Surface modification of nanofibrils can be achieved by several methods. Two methods, recently demonstrated by PFI research groups are described in this issue, which also emphasize the chemical and structural characterisation of modified fibrillated materials.

### Upcoming events

Annual meeting of IAWS 2011, Novel materials from wood or cellulose. Stockholm, August 31-Sept. 2. [Read more...](#)

Progress in Paper Physics Seminar, Graz, September 5-8, 2011. [Read more...](#)

IARIGAI. 38<sup>th</sup> International Research Conference, September 11-14, 2011. [Read more...](#)

### Recommended links

PFI:

[www.pfi.no](http://www.pfi.no)

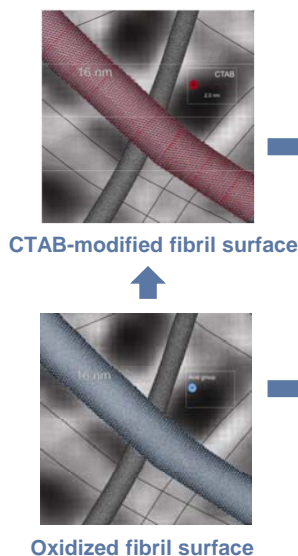
INNVENTIA:

<http://www.innventia.com>

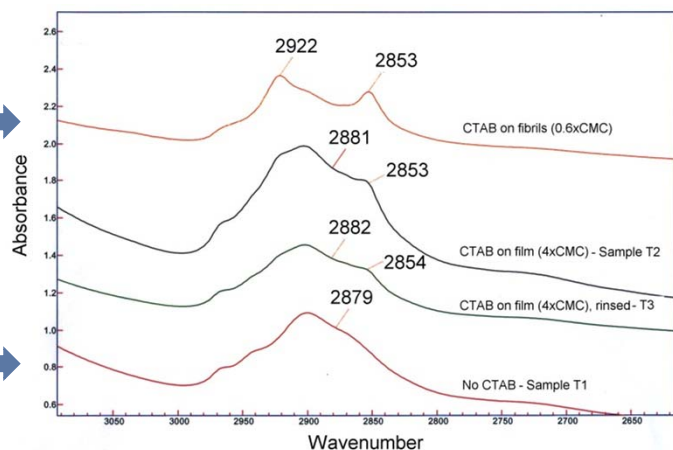
### Next issue, January 2012

- Bio-energy

### Selected analysis method



### Fourier transform infrared spectroscopy (FTIR)



FTIR spectra of unmodified and CTAB modified fibrils and films

### Editor

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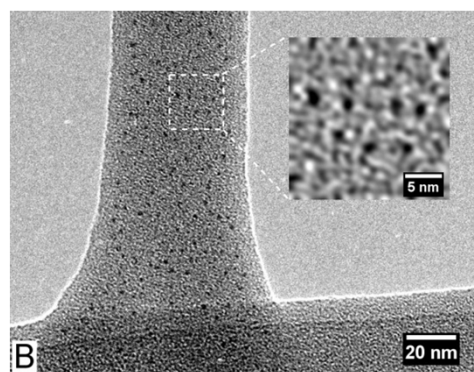
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### CTAB-modified films

## Films made of cellulose nanofibrils - surface modification by adsorption of a cationic surfactant and characterisation by computer-assisted electron microscopy

### Abstract

Films made of nanofibrils were modified by adsorption of a cationic surfactant directly on the film surfaces. The nanofibrils were prepared by TEMPO-mediated oxidation and mechanical fibrillation and were relatively homogeneous in size. The average nanofibril diameter and surface porosity was quantified based on computer-assisted field-emission scanning electron microscopy (FE-SEM). The cationic surfactant used in the adsorption was n-hexadecyl trimethylammonium bromide, (cetyl trimethylammonium bromide, CTAB).



The adsorption of CTAB was confirmed by Fourier transform infrared (FTIR) spectroscopy and high-resolution transmission electron microscopy (HRTEM) analyses. It was shown that the adsorbed layer of CTAB increased hydrophobicity, without affecting the tensile index significantly. This capability, combined with the antiseptic properties of CTAB, may be a major advantage for several applications.

The figure shows a high-resolution transmission electron microscopy image of a single CTAB-modified nanofibril. Note the CTAB molecules appearing as black dots on the fibril surface.

Reproduced from Syverud et al. (2010).

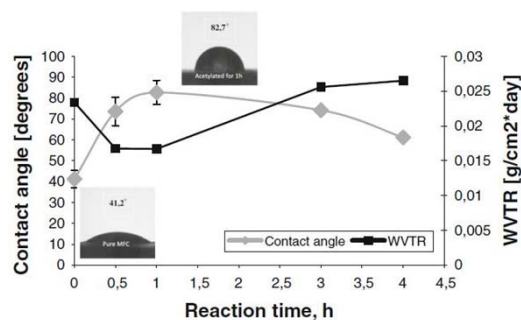
Reference: Syverud, K., Khanari, K., Chinga-Carrasco, G., Yu, Y., Stenius, P. J. Nanoparticle res. 13(2): 773-782 (2010).

### Chemical modification

## Surface chemical modification of microfibrillated cellulose: improvement of barrier properties for packaging applications

### Abstract

Heterogeneous acetylation of microfibrillated cellulose (MFC) was carried out to modify its physical properties and at the same time to preserve the morphology of cellulose fibrils. The overall reaction success was assessed by FTIR together with the degree of substitution (DS) defined by titration and the degree of surface substitution (DSS) evaluated by means of XPS. Dynamic contact angle measurements confirmed the hydrophobicity improvement relative to non-modified samples. The increase of contact angle upon reaching a certain reaction time and some decrease following the further acetylation was confirmed.



Mechanical properties of MFC films made from chemically modified material were evaluated using tensile strength tests which showed no significant reduction of tensile strength. According to SEM images, dimension analysis and tensile strength data, the acetylation seemed not to affect the morphology of cellulose fibrils.

The figure shows Contact angle versus WVTR for various reaction times.

Reproduced from Rodionova et al. (2011).

Reference: Rodionova, G., Lenes, M., Eriksen, Ø. and Gregersen, Ø. Cellulose 18(1): 127-134 (2011).

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