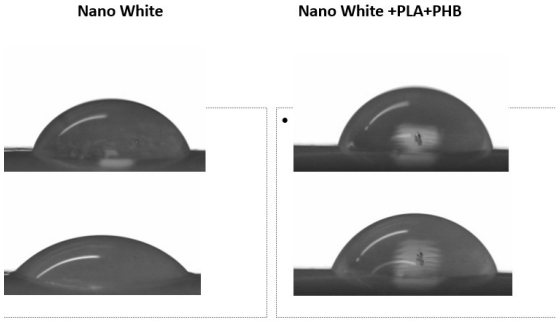
Adriane Cherpinski Correa Report of the STSM

The project objective was to characterize the surface properties of a high barrier active biodegradable material with barrier properties for its application as fiber based food packaging material. The material is obtained from renewable resources and by-products, making it more sustainable. The structure of the packaging material is made of a nanocelullose film resembling paper board developed by VTT coated on both sides by an electrospun active PHA coating developed by CSIC. The mission at the VTT laboratories was to carry out the characterization of some surface properties that include Mechanical Properties (LS5 Lloyd Instruments Universal Testing Machine), Atomic Force Microscopy (AFM) (AFM tapping mode; Park Systems XE-100 with 905-ACTA cantilever) and Contact Angle Measurements (CAM 200 KSV Instruments Ltd., Helsinki, Finland) video camera based fully computer-controlled contact angle meter. Samples: PHB (Biomer)+ncn White (bleached hardwood kraft E206h75MIF7), PHB+ncn Yellow (unbleached softwood E233USWM2F5), PHBV (Tianan)+ncn W, PHBV+ncnY, Ncn White, Ncn Yellow, PHB Film, PHB Fibers, PHBV Film, PHB Fibers, PHB+ncn Y (heat treatment), PHB+ncn Y (heat treatment /colling/ water), PHB+PLA+ncn White, PHB+PLA+ncn Y.

Contact angle measurements were carried out for all the samples and it was seen that, as expected, the coated paper had a more hydrophobic surface behavior than the uncoated nanocellulose paper making this more adequate for use. The film coated with electrospun PLA had a slightly higher hydrophobic nature than the other biopolyester coated samples based on PHA.

Table 1: Contact Angle Measurements

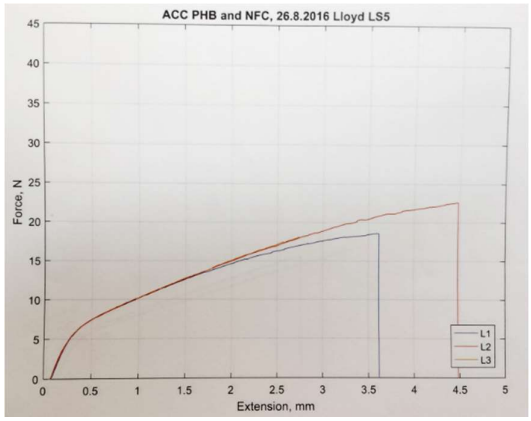
Sample	Drop – 1	Drop - 2	Drop - 3
	Range	Range	Range
Nano white	51.17-36.24	57.15-39.24	55.55-39.50
Nano yellow	66.07-19.57	64.85-49.03	65.32-46.17
Phb film	81.82-76.06	82.45-75.07	85.72-77.04
Phbv film	78.32-76.73	79.09-76.56	77.71-74.62



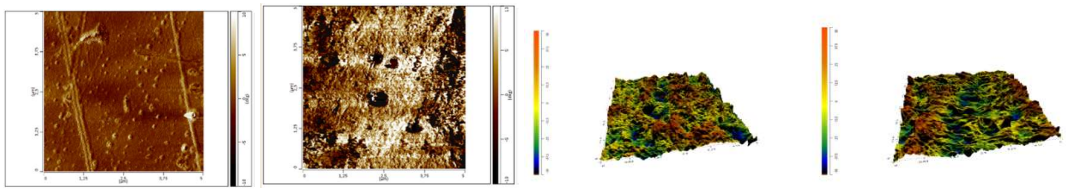
Mechanical properties were also determined by doing tensile tests, from these it was seen that the storage modulus and tensile strength for the white nanocellulose paper was higher than the yellow nanocellulose paper, which indicates that the white nanocellulose is more rigid than the yellow nanocellulose. Both materials were made more flexible by coating with electrospun biopolyesters. This is a significant finding that is currently being explored further.

Table 2: Mechanical properties.

Samples	E (MPa)	σR (MPa)	%εR
NanoCel White	4806.5 (105)a	152.3 (9.3)a	20.2 (2.2)a
NanoCel Yel	3752.1 (184)b	109.6 (10.2)b	14.2 (0.5)cde
PHB Film	1307.5 (69)ghi	14.1 (0.6)h	2.9 (0.2)g
PHBV Film	1940.4 (155)cd	28.0 (4.8)fgh	2.8 (0.1)g



Finally the topography of the coated materials was checked by AFM and the sampled coated with PLA exhibited the smoothest roughness of all (see figure below). Further experiments are being now carried out at both ends to extract more information on the materials and will be reported in the next meetings of the COST action.



AFM of PLA (left) and PHB (right) coatings / 3d PHB+white ncn and Phb Yellow cnc