“Flexible polyaniline-bacterial nanocellulose conducting composites”

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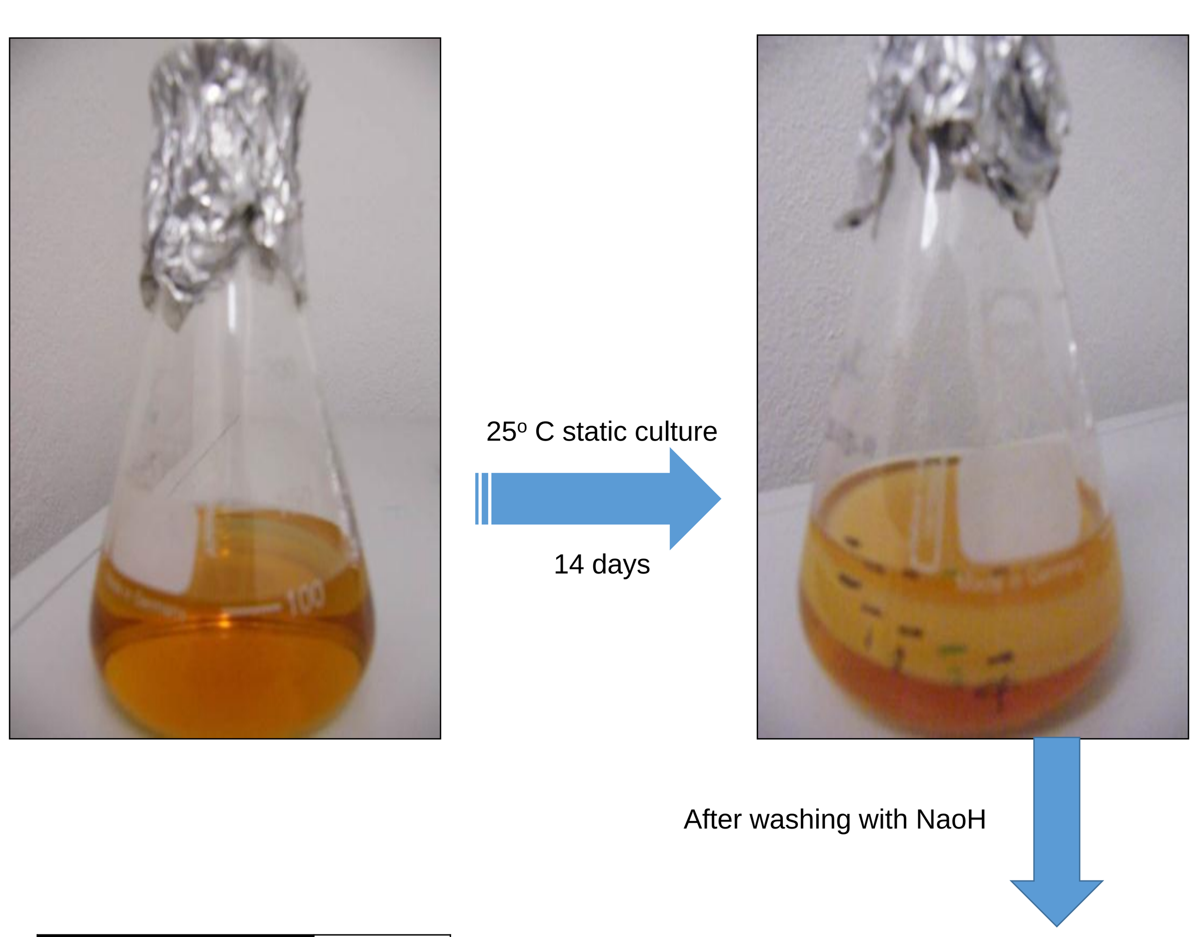
Abstract

Development of new greener material for conducting paper is sought for applications such as security paper, actuators, and anti-static packaging. It is required that the material for these applications possess low density and good mechanical integrity. This work presents a way to produce bacterial nanocellulose (BC) - polyaniline (PANI) nanocomposites by *in situ* polymerization in suspension of cellulose nanowhiskers. The advantages of using BC over filter paper are its ultrafine network structure, sufficient porosity, high purity and crystallinity, good mechanical properties, great water holding capability and low environmental impact. The BC/PANI composites formed by optimized synthesis of PANI within cellulose nanowhiskers are expected to possess good electrical conductivity in addition to excellent mechanical properties and flexibility. The material has been characterized using Fourier Transform Infra-Red Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM).

Production of Bacterial Cellulose



Distilled water	1 L
Glucose	20 gm
Peptone	5 gm
Yeast	5 gm
Sodium Phosphate	3.4 gm
Citric acid	1.15 gm

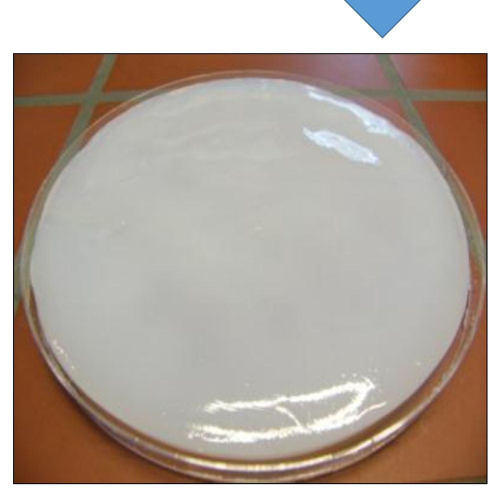


Figure 1:- Bacterial Cellulose Preparation

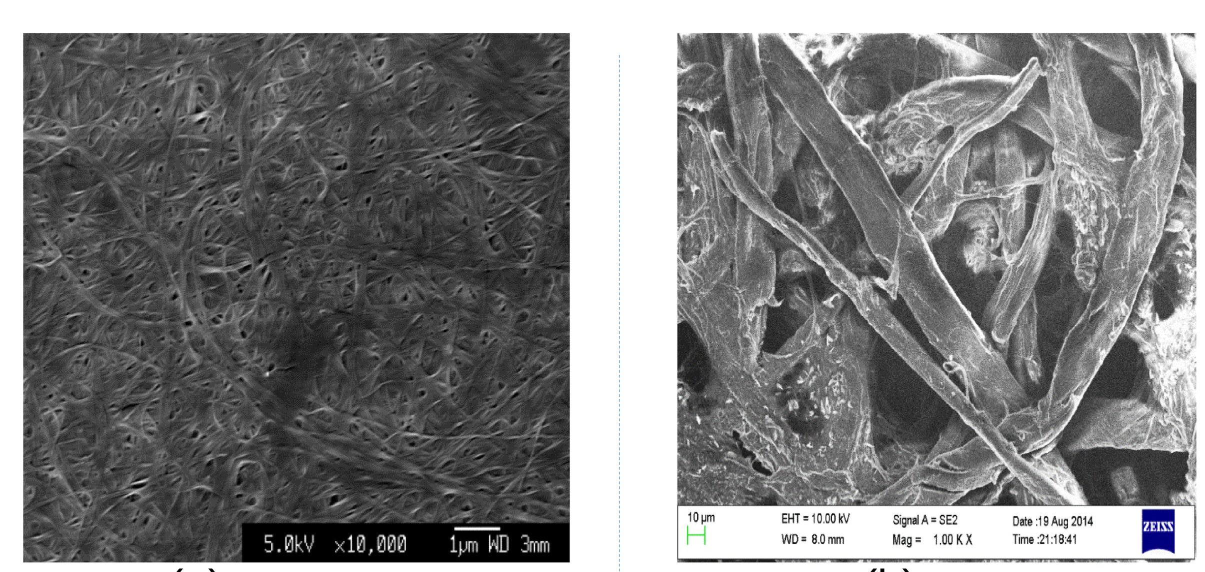
Result and Discussion

1. Choice of substrate

A. Visually

(a) (b)
Figure 2:-Image of (a) Bacterial Cellulose and (b) Filter Paper

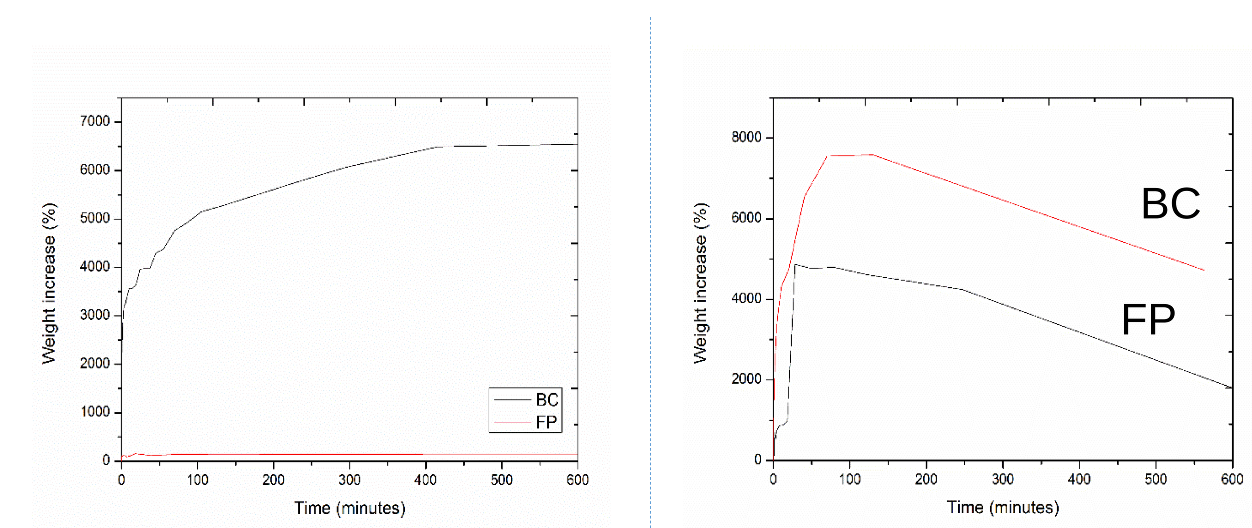
B. Microstructure



(a) (b)
Figure 3:-SEM Image of (a) Bacterial Cellulose and (b) Filter Paper

Indicates
1) BC is made up of nanodimensional fibrils while FP is made up of micron dimensional fibrils
2) BC overall has higher porosity than FP

The differences are attributed to different production routes and source.



(a) Toluene (b) Hydrochloric acid

Figure 4- Penetration Study of Bacterial cellulose and Polyaniline

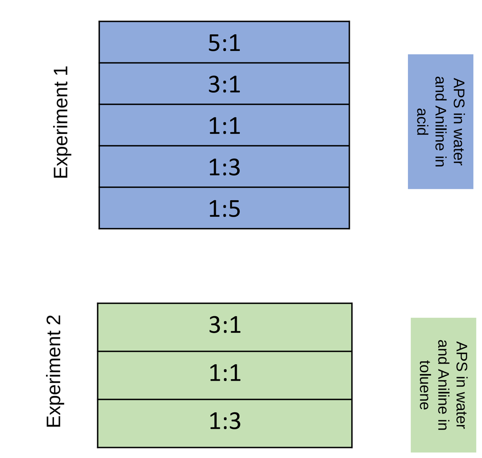
It indicates the better porosity and holding capacity of BC over FP

Result and Discussion

2. Synthesis

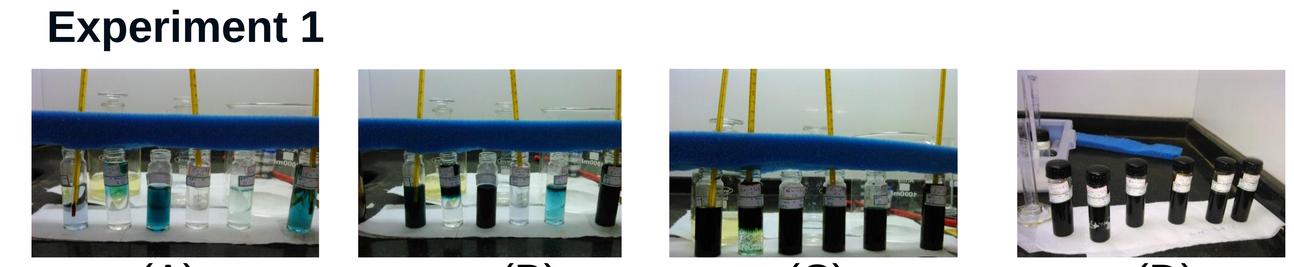
Synthesis variables	
	Solvents (Acid+water/toluene+water)
	Molar ratio of APS:Aniline
	Time and temperature of polymerization
	Washing and drying time

APS	Aniline
water	acid
water	toluene



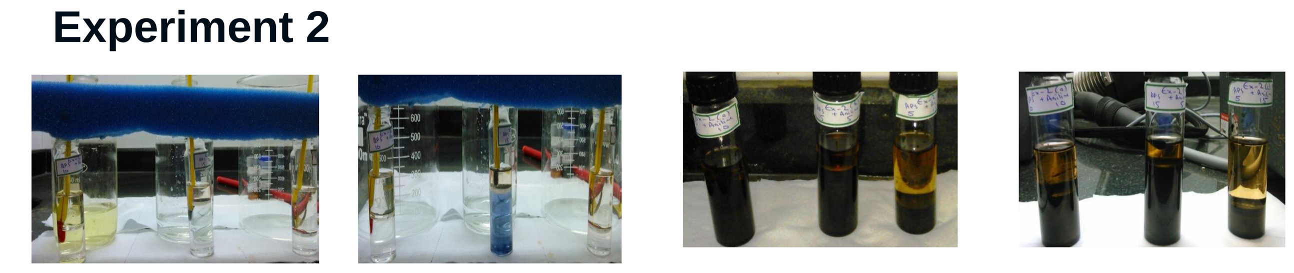
A. Visually-Snapshot at regular time intervals

Experiment 1



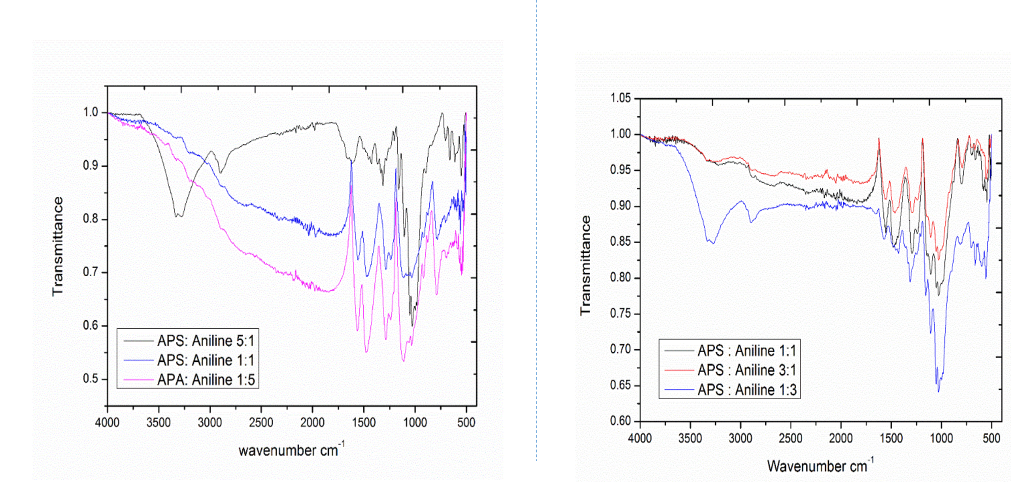
(A) (B) (C) (D)

Experiment 2



(A) (B) (C) (D)

B. FTIR



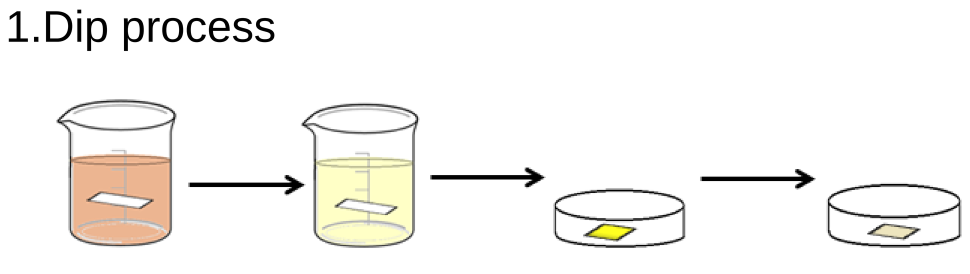
(a) (b)
Figure 5:- FTIR Spectra for experiment (a) set 1 and (b) set 2 with indicated molar ratios

It confirms the formation of polyaniline as the required peaks for functional groups like N-H,C-N etc. seen in nearly all the samples.

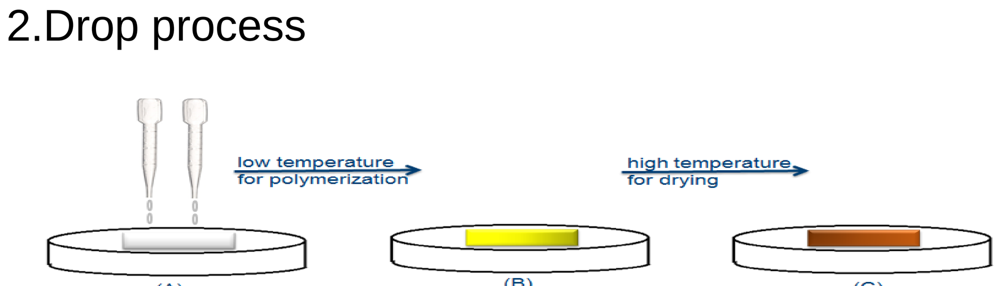
Future work

Further composite have to be prepared and characterised through various strategies and we need to optimize the protocol it. Some of the strategies include:-

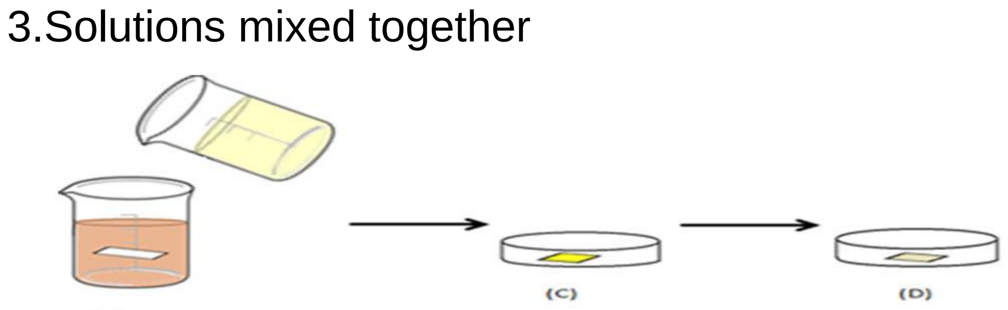
1.Dip process



2.Drop process



3.Solutions mixed together



Conclusion

1. BC is a better candidate as a substrate because of its higher porosity and continuous morphology .
2. Optimised synthesis protocol for conducting polyaniline is 1:1 due to high yield and formation of conductive polyaniline which was confirmed by FTIR
3. Discussion of composite strategies