

Route to conducting nanocomposites by simultaneous *in situ* polymerization of aniline and matrix assembly from bacterial cellulose nanowhiskers

Divya Anand, Dr. Mudrika Khandelwal
 Department of Materials Science and Metallurgical Engineering
 Indian Institute of Technology, Hyderabad
 Ordinance Factory Estate, Yeddumailaram, Medak, Telangana 502205
¹Email address: ms13m1004@iith.ac.in
²Email address: mudrika@iith.ac.in



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 of aniline in suspension of cellulose nanowhiskers. 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 FTIR, SEM and 4-probe conductivity measurement equipment.

EXPERIMENTS

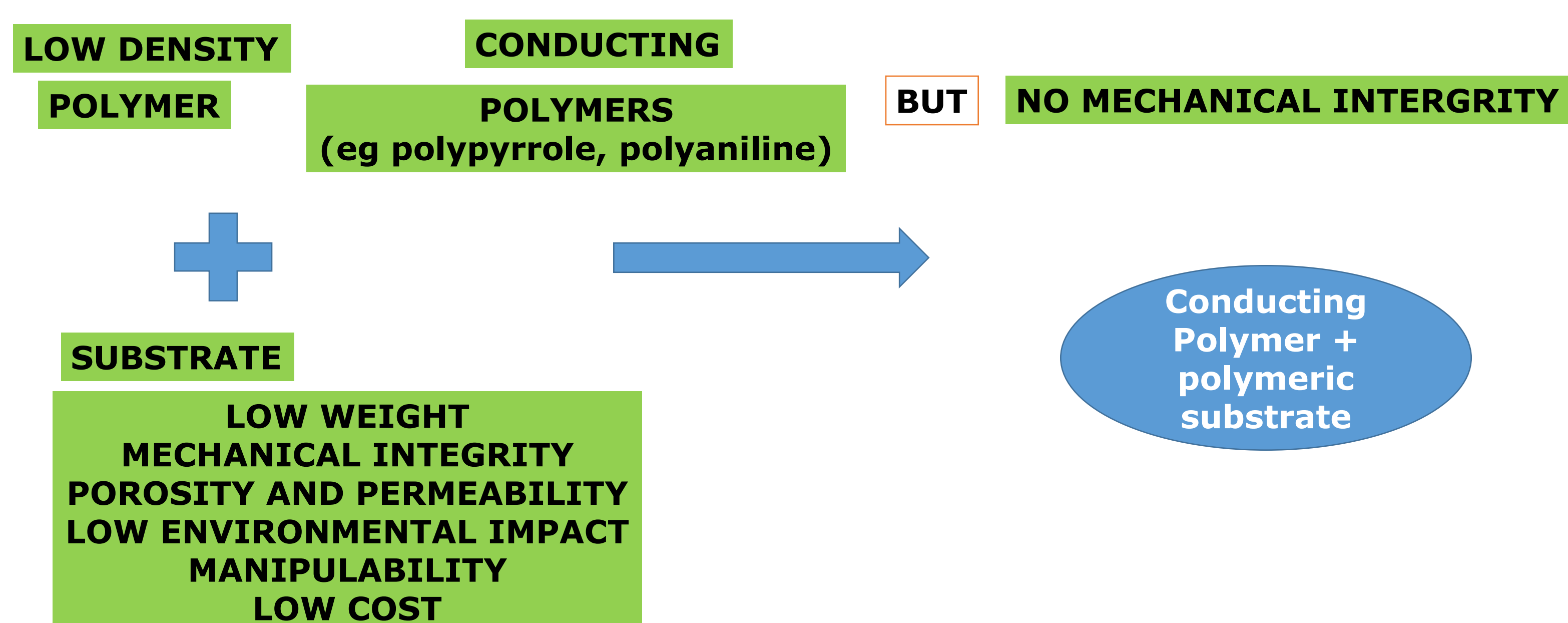


Figure 1:-Characteristics for the materials to be used for flexible electronics application

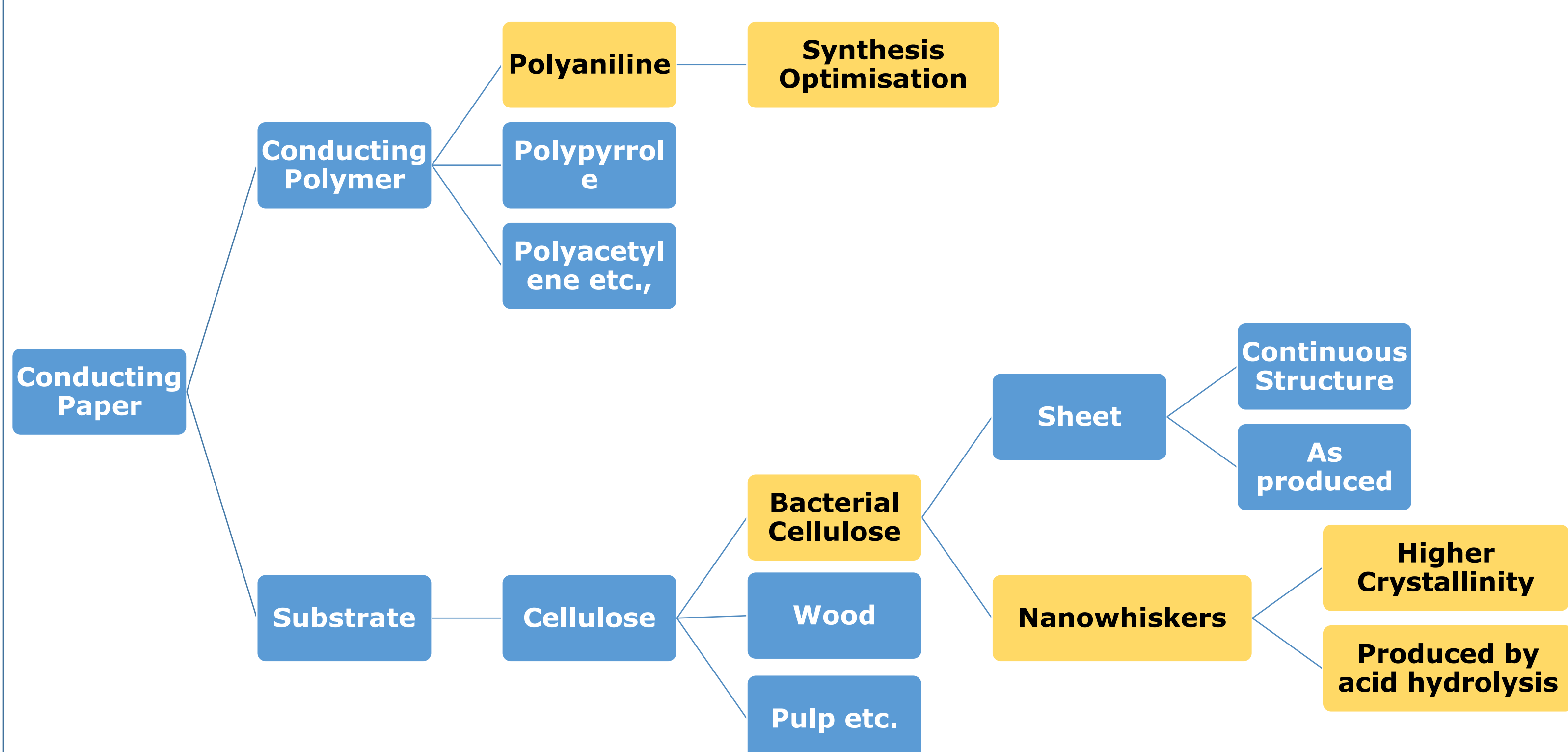


Figure 2:-Components of Polymer Composite for Conducting Paper

RESULTS & DISCUSSION

1. Polyaniline Synthesis Optimisation

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

Experiment	Molar Ratio (APS:Aniline)	Solvent
Experiment 1	5:1	water and Aniline in acid
	1:1	
	1:5	
Experiment 2	3:1	water and Aniline in toluene
	1:1	
	1:3	

Figure 3:-Experiments planned for obtaining protocol for highly conducting PANI

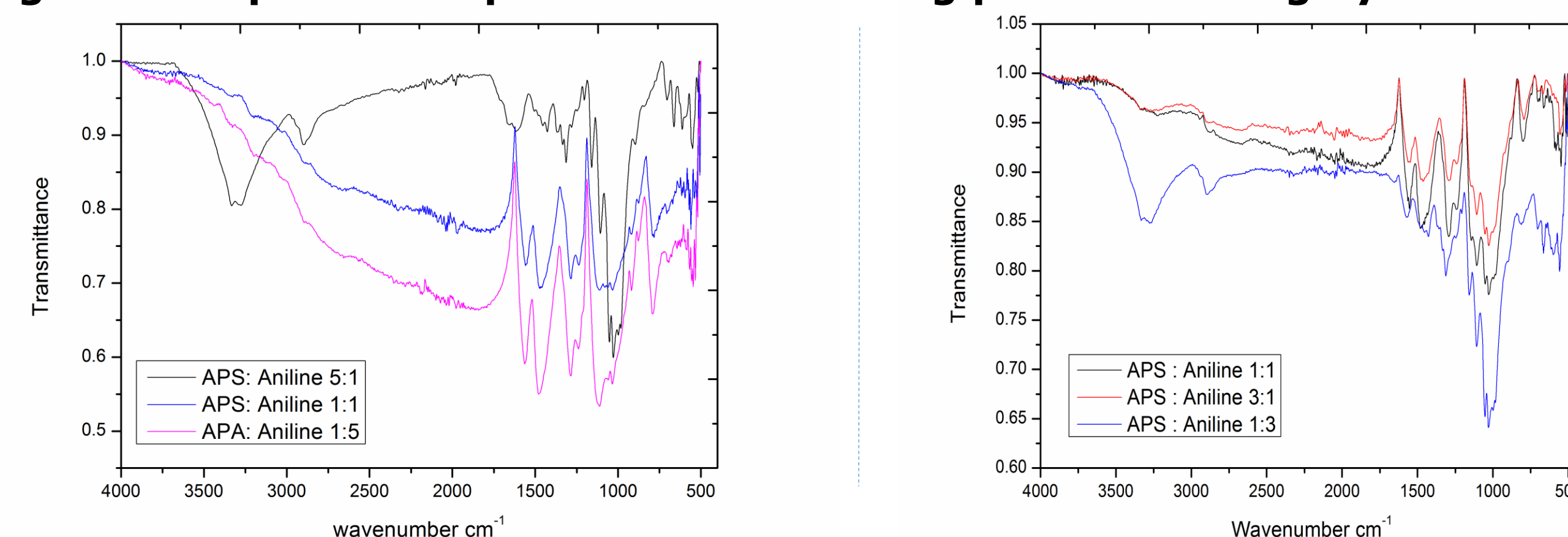


Figure 4:- FTIR Spectra for experiment (a) set 1 & (b) set 2 with indicated molar ratios

The FTIR confirms the formation of polyaniline as the peaks for required functional groups were observed in 1:1, 1:3 and 3:1, out of which yield is best for molar ratio 1:1.

2. Composite Preparation

a. From Bacterial Cellulose Sheet

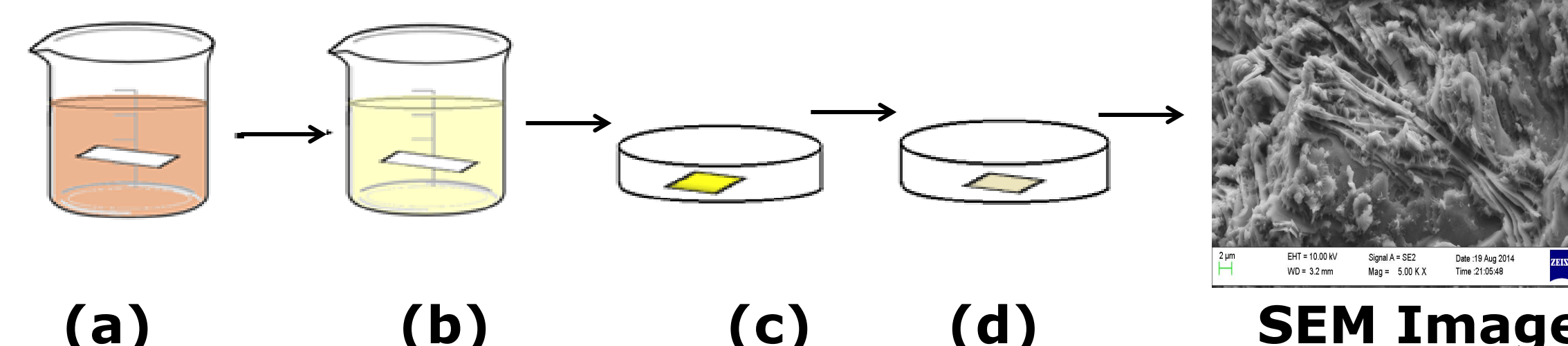


Figure 5:- Composite Preparation from BC sheet (a) BC dipped in Aniline solution (b) then in APS solution (c) kept at low temperature for polymerization and (d) dried at higher temperature

A good coating of polyaniline can be observed on BC as seen from SEM image of the composite.

b. From Nanowhiskers

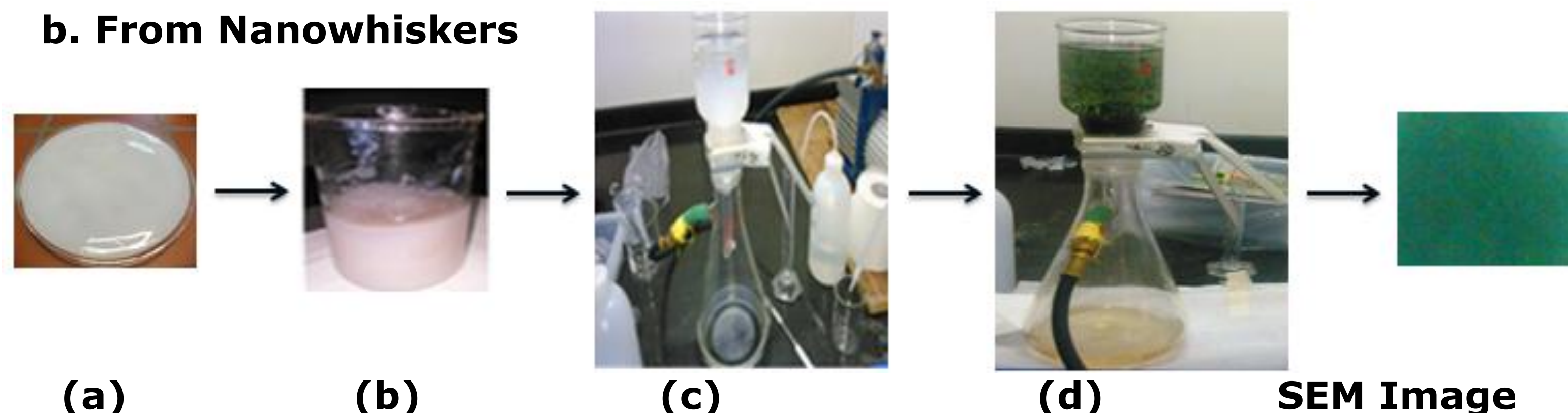


Figure 6:- Composite Preparation from BC sheet (a) BC Sheet (b) Acid hydrolysed (c) washing to obtain nanowhiskers (d) mixing all ingredients for sheet preparation. In this method, the matrix assembly takes place along with polymerization.

CONCLUSIONS & FUTURE WORK

- Optimised synthesis protocol for conducting polyaniline is 1:1 due to high yield and formation of conductive polyaniline which was confirmed via FTIR.
- Nanowhiskers are better substrate than Sheet form of BC due to its homogeneity which is expected due to uniform chemistry.
- Optimization for several parameters have to be done in near future.

ACKNOWLEDGEMENT

- I thank my seniors (Ravi and Dan Satyaraj) for helping me using FTIR and SEM respectively.