

The formation of tube and nanotube of polyaniline

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Synthesis of Polyaniline Hierarchical Structures in a Dilute SDS/HCl Solution: Nanostructure-Covered Rectangular Tubes

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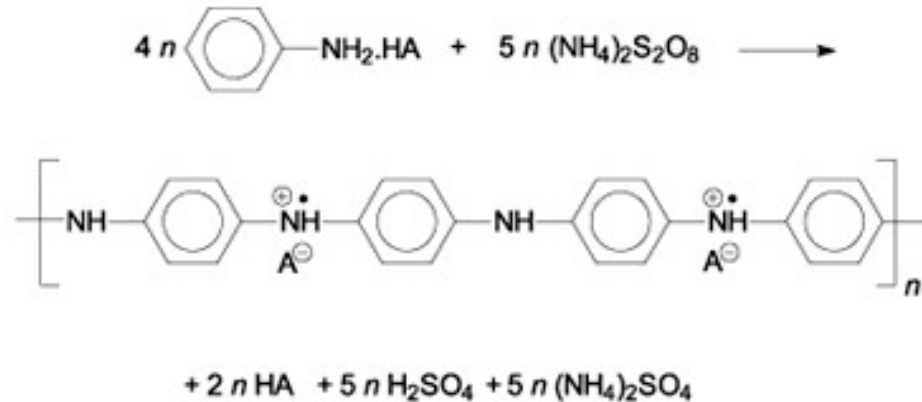
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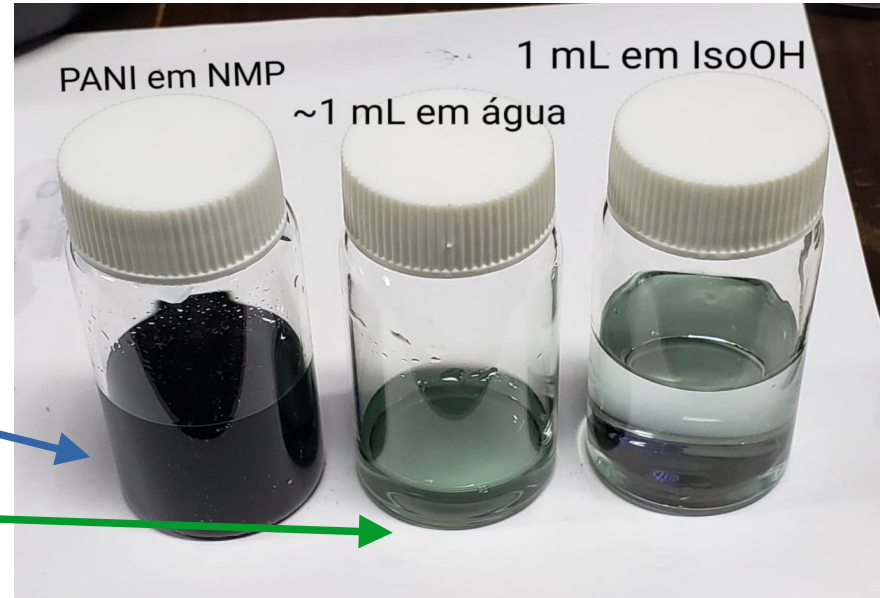
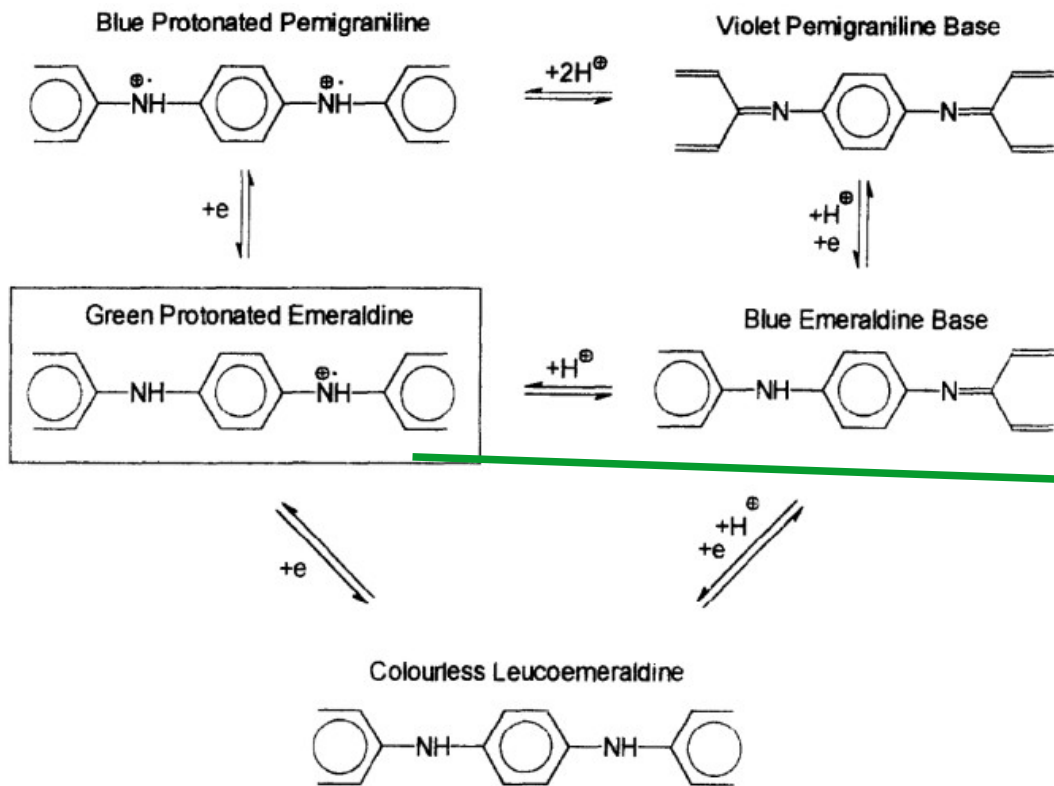
ABSTRACT: We reported the synthesis of nanostructure-covered rectangular submicrotubes of polyaniline in the doping state via the oxidation polymerization of aniline in the acidic solution of anionic surfactant. Both the concentrations of surfactant and inorganic acid employed in this preparing system are relatively low, which were essential to the successful fabrication of polyaniline hierarchical structures. We discussed the temperature dependence of polyaniline morphology and found that this synthesis admitted a wide range from 20 to 40 °C. After observing their growth processes, a tentative interpretation has been proposed to elucidate the formation of the tubular hierarchical structures in such a system. It was also found in this report that both SDS and HCl had profound impacts on the morphology of resulting product.

Introduction

- Polyaniline is a conductor polymer that we can obtain with the reaction shown below.

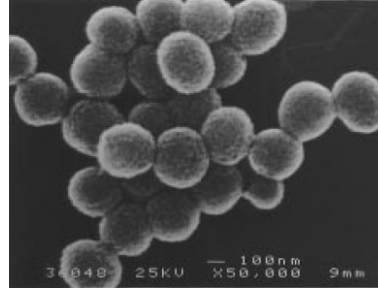


- Characteristics:
 - Semiconductor polymer (It depends on pH of the solution);
 - Change the color (index refraction) when the polymer have different charges.

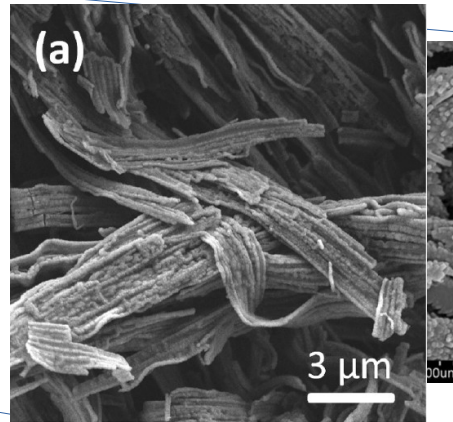


- Because these characteristics are of interest that produce different types of molecules using polyaniline. Like:

- Particles;

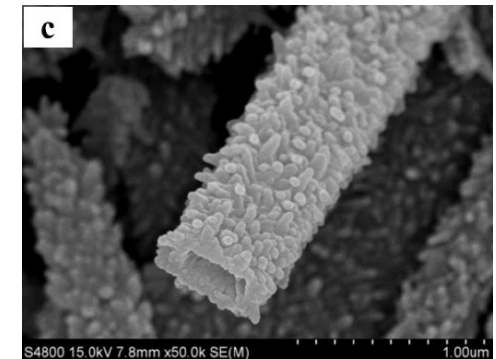
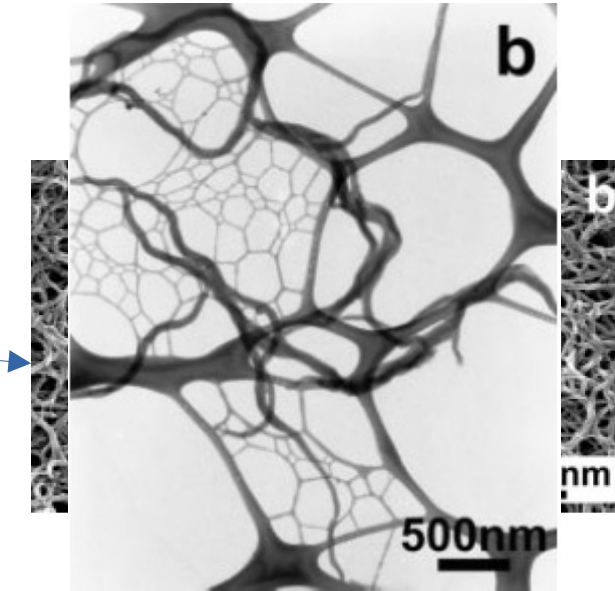


- Nanofibers;



- Nanorods;

- Tubes;



1D {

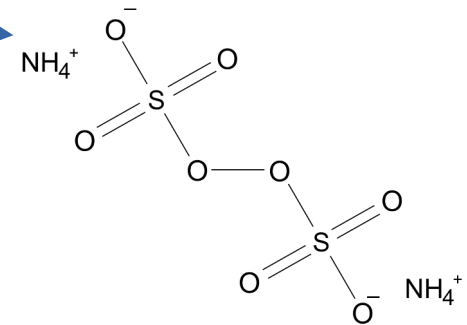
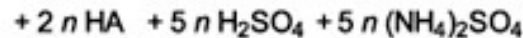
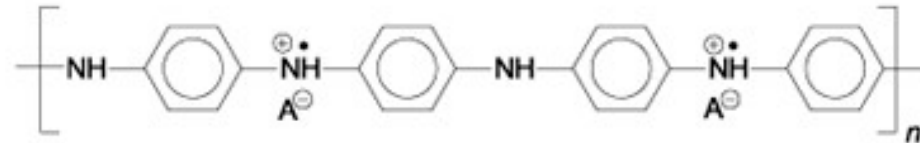
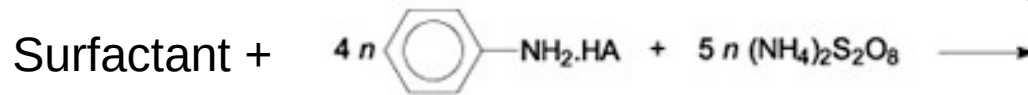
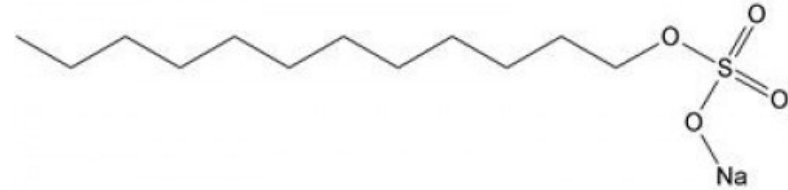
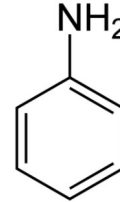
Objective

- Study the influence of temperature, reaction time, surfactant concentration and acid concentration in solution for the tube formation.

Synthesis

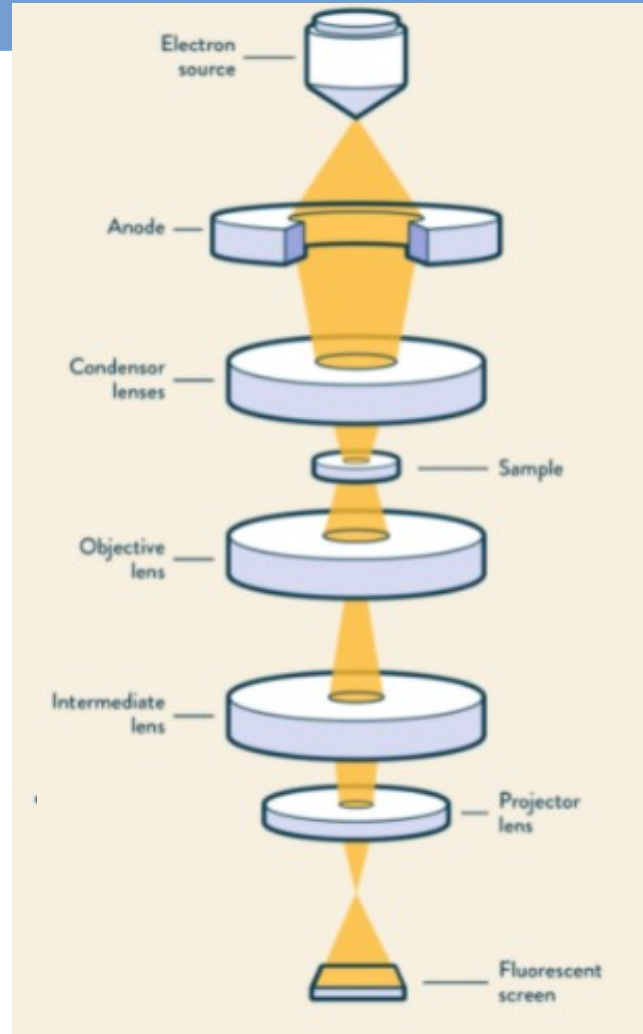
- Tube synthesis is similar to polymer. The author using:

- Aniline;
- Hydrochloric acid (HCl);
- Sodium dodecyl sulfate (SDS);
- Ammonium persulfate.



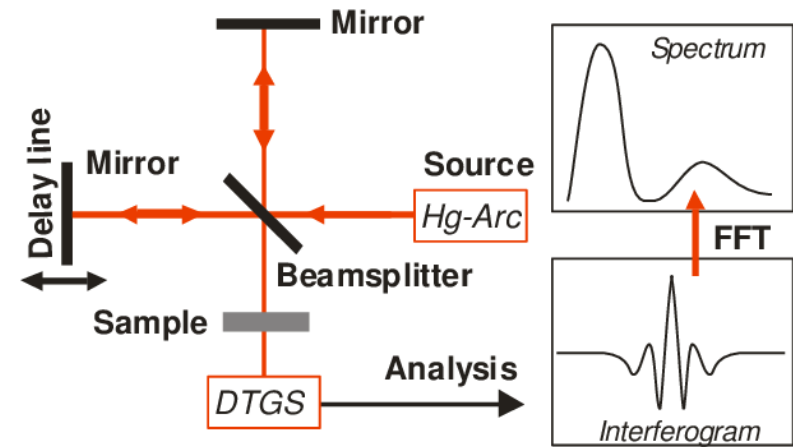
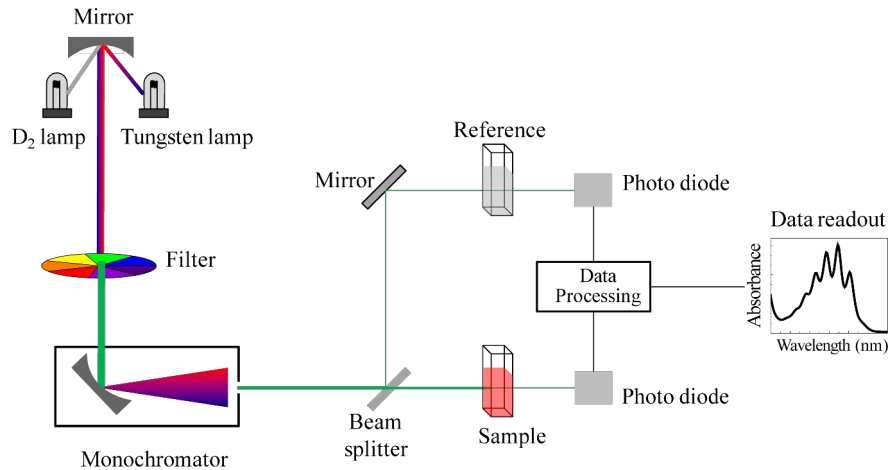
Experimental techniques

- Field-emission scanning electron microscope;
- Transmission electron microscope;
- Fourier transform infrared spectroscopy;
- UV-vis spectrophotometer.



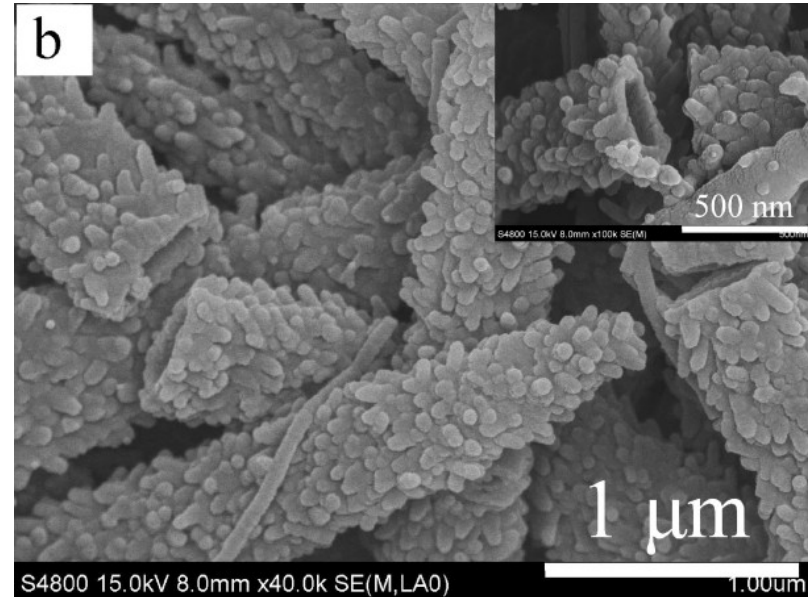
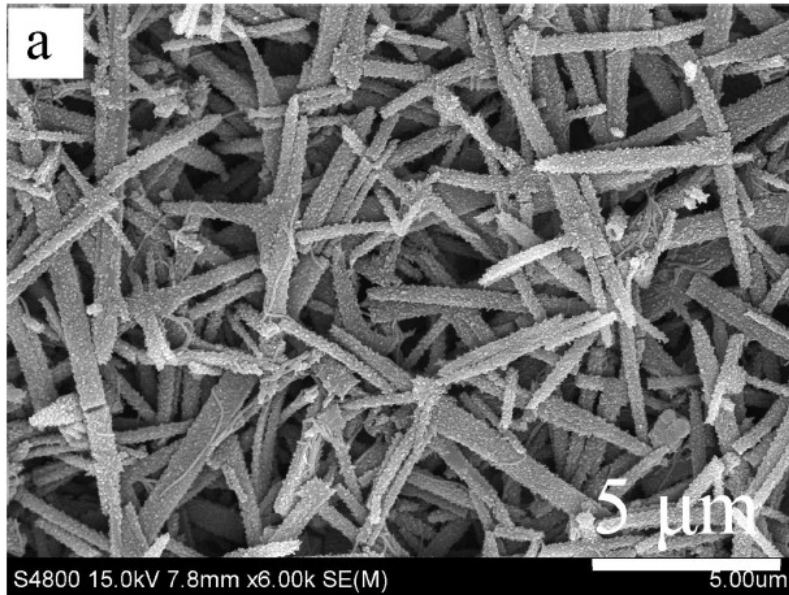
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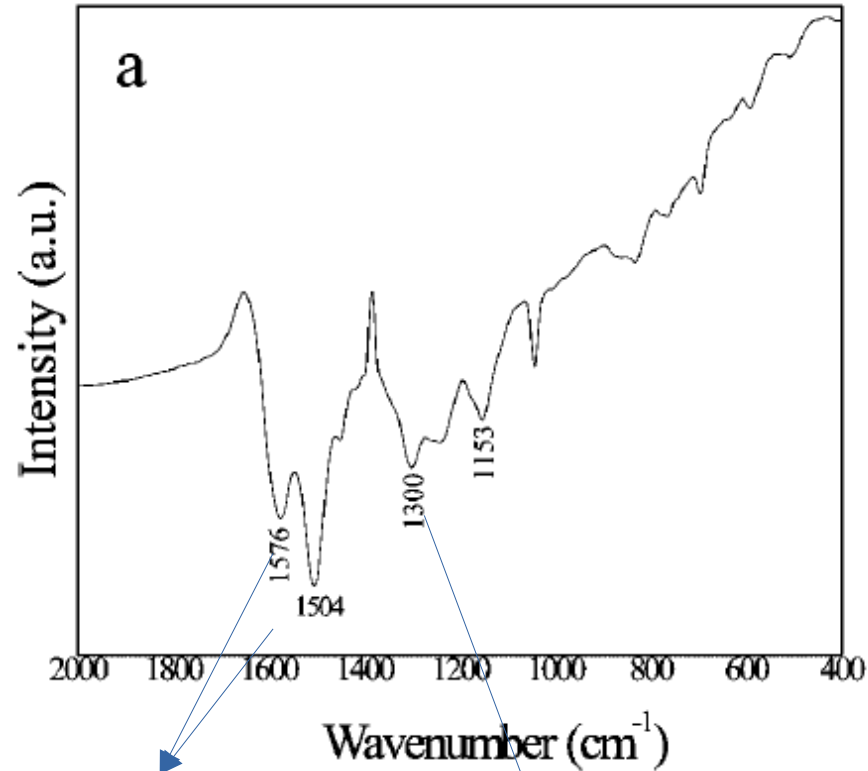


Results

- Using the Field-emission scanning electron microscope with [SDS] = 0.53 mM and [HCl] = 0.38 mM at ambient temperature.
- The tubes diameter is 400-600 nm and length is few micrometers. Nanorods diameter is 50-70 and length is 100-150.



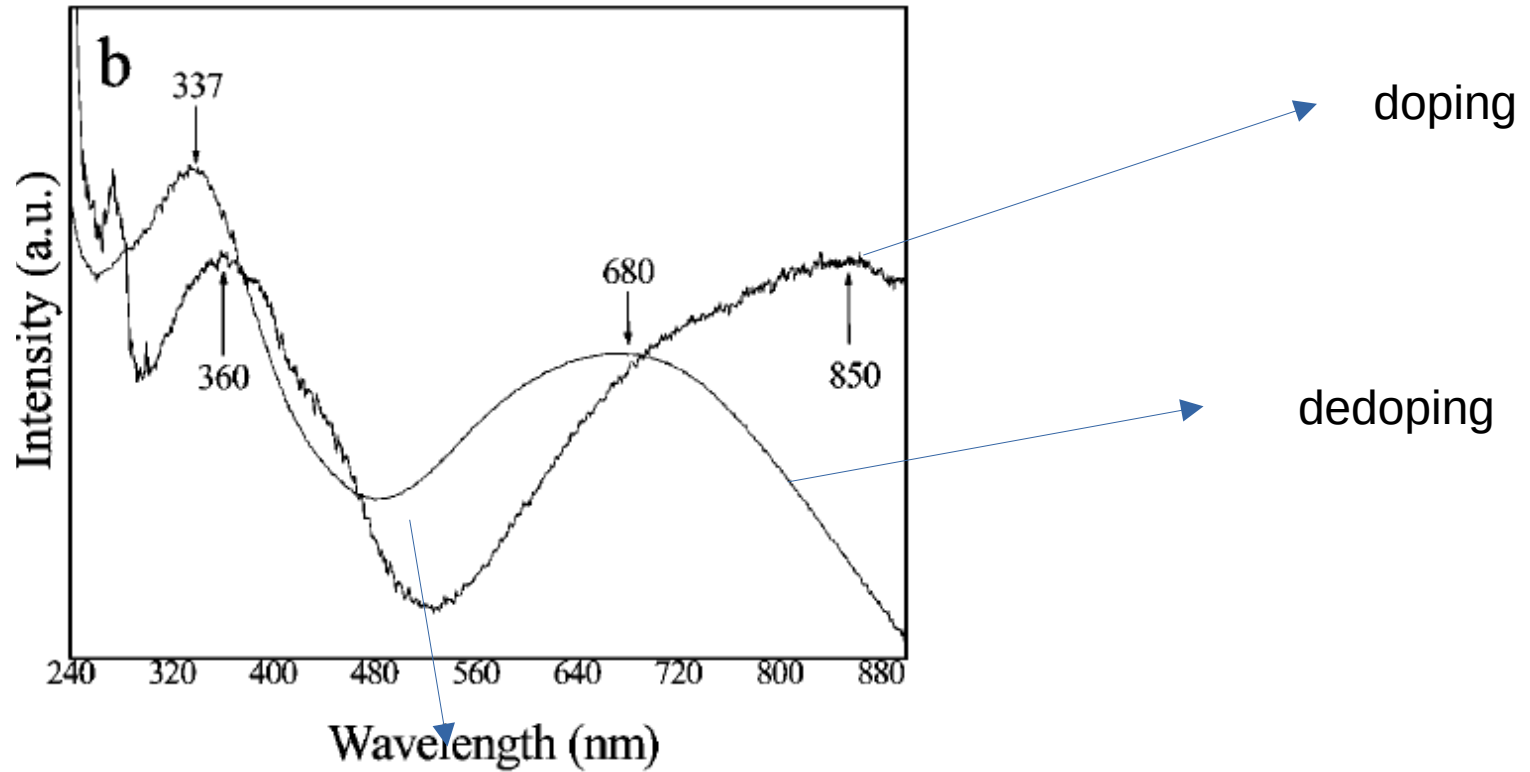
- Using the Fourier transform infrared spectroscopy we can obtain the figure below:



Vibration C=C (quinoid and benzenoid rings) this structure is present in the polymer (PANi).

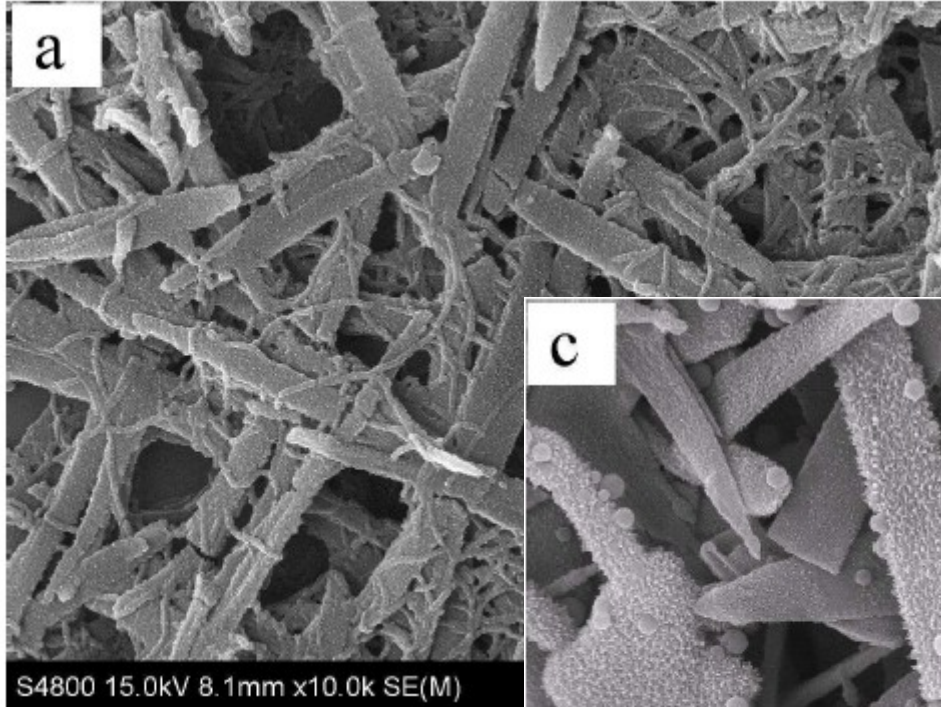
Vibration C-N

- Using the UV-vis spectrophotometer we can obtain the figure below:

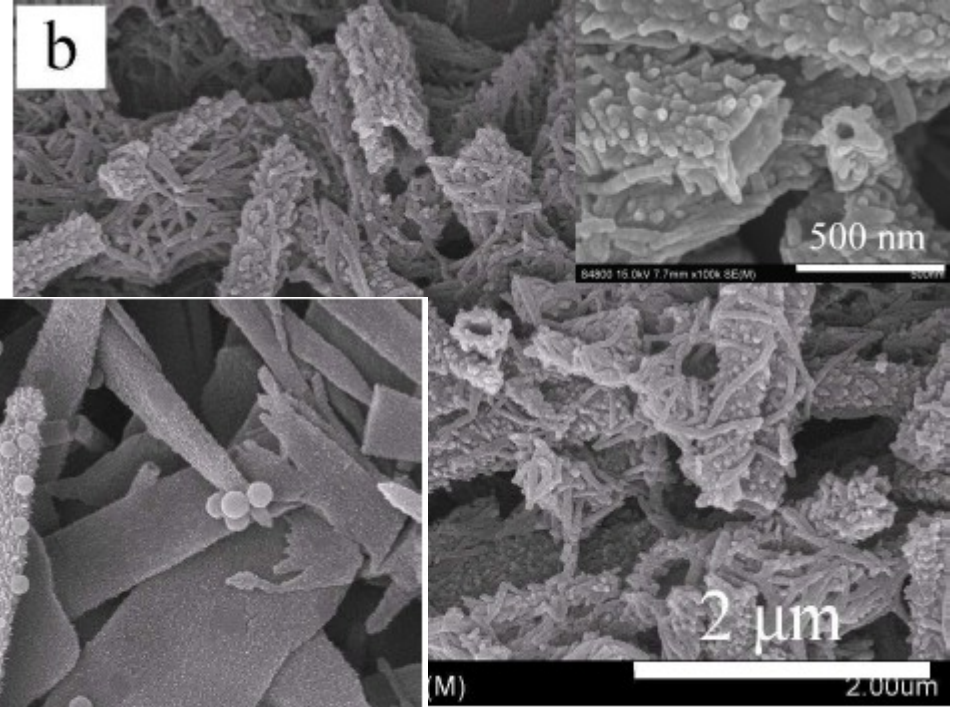


No have a peak in this region.
This is a evidence a possibly
owing to the doping of SDS in
Product.

- Temperature influence



-10 °C

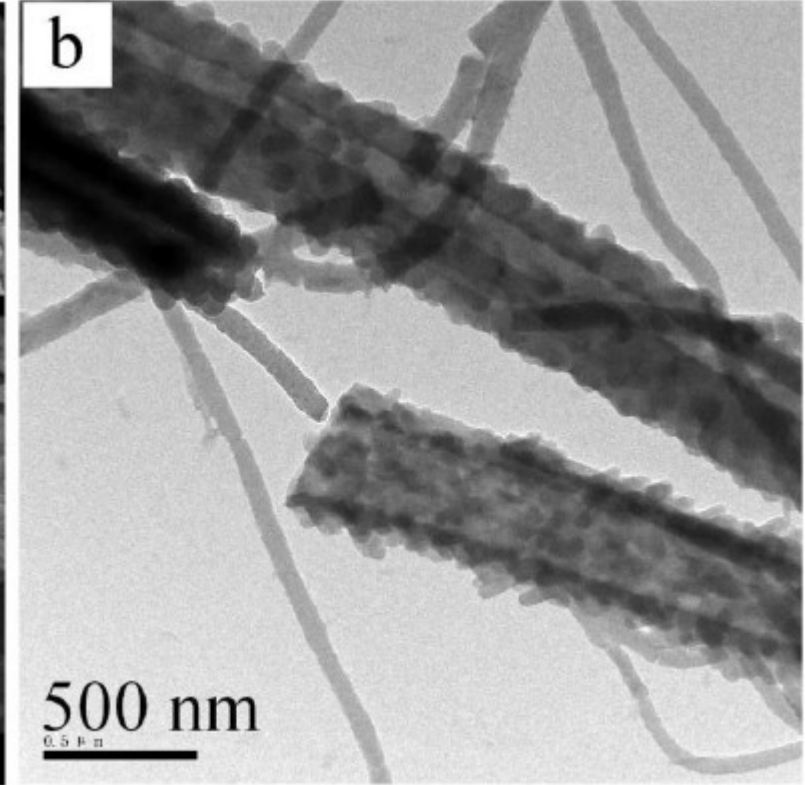
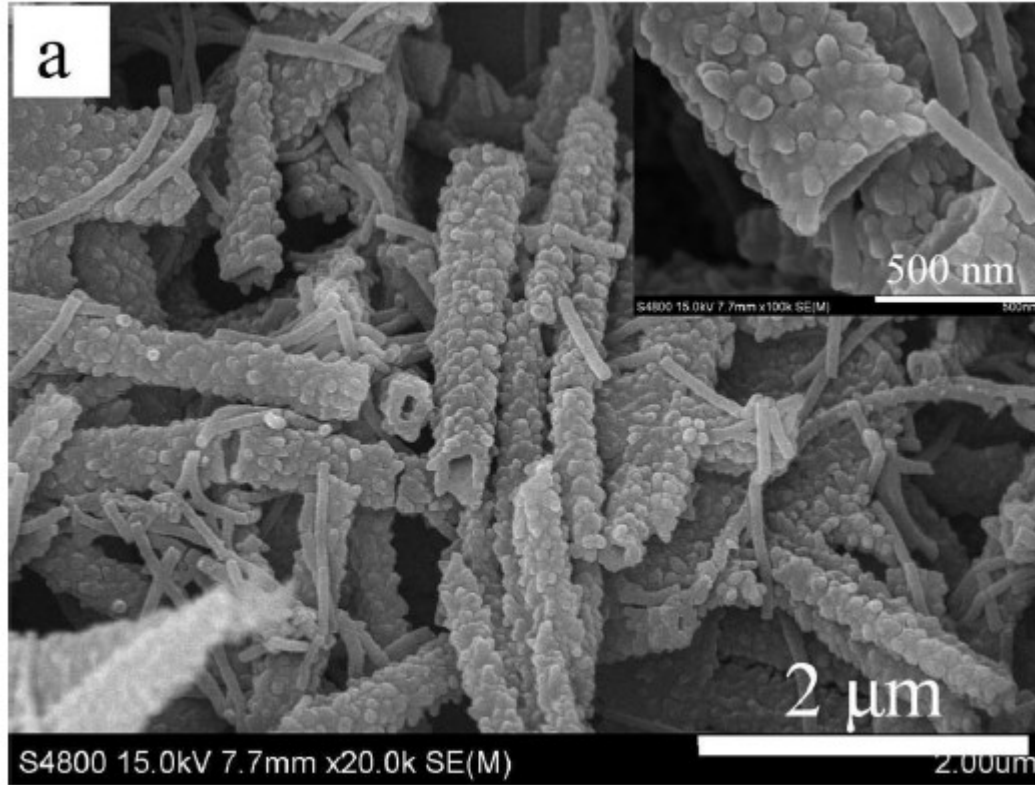


5 °C

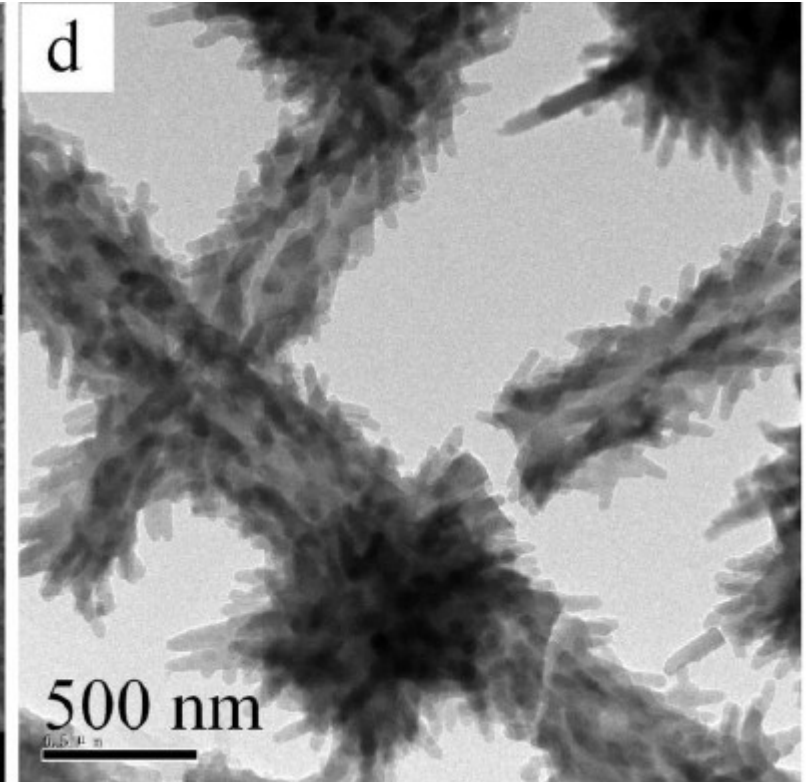
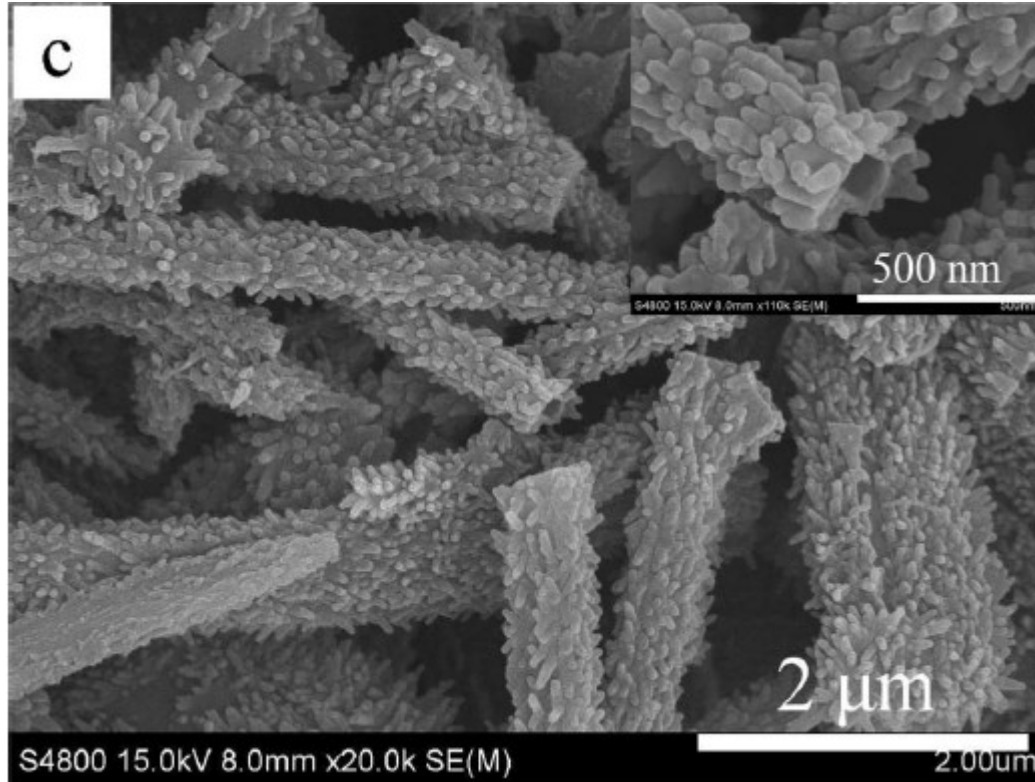


50 °C

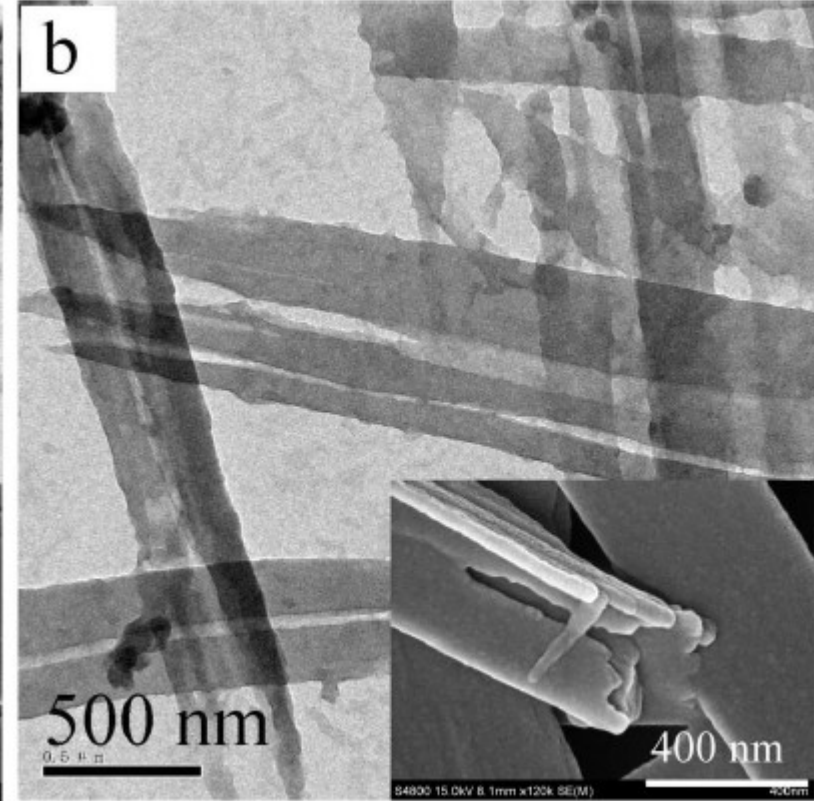
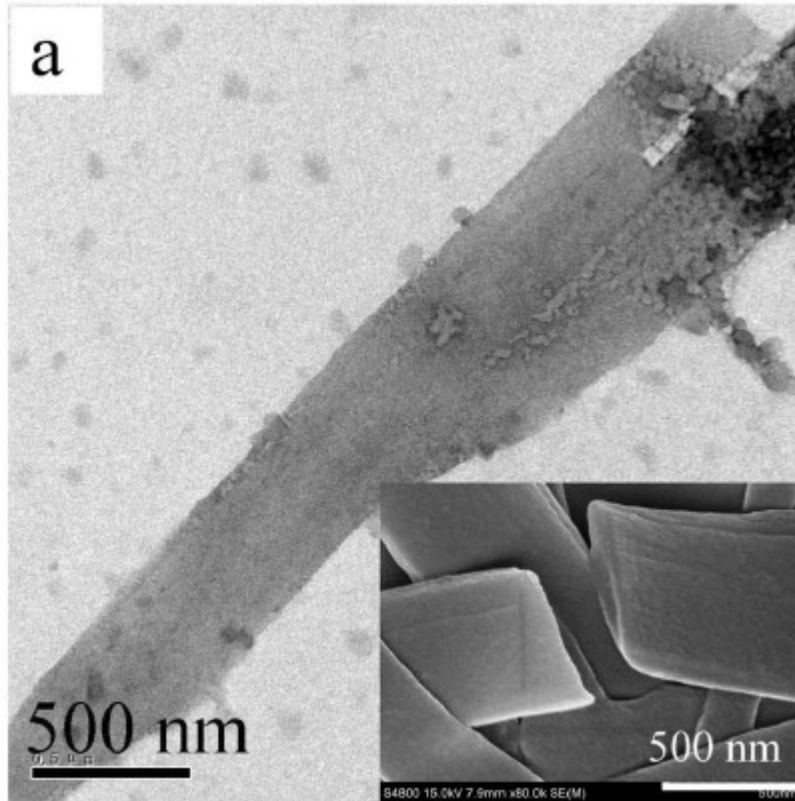
- Temperature influence (20 °C)



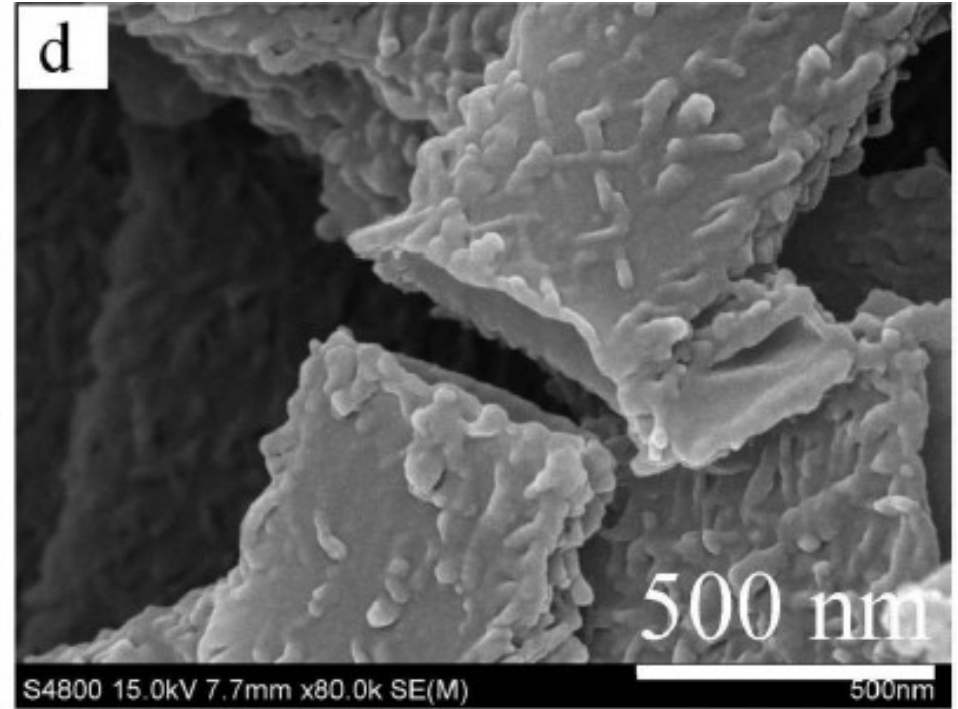
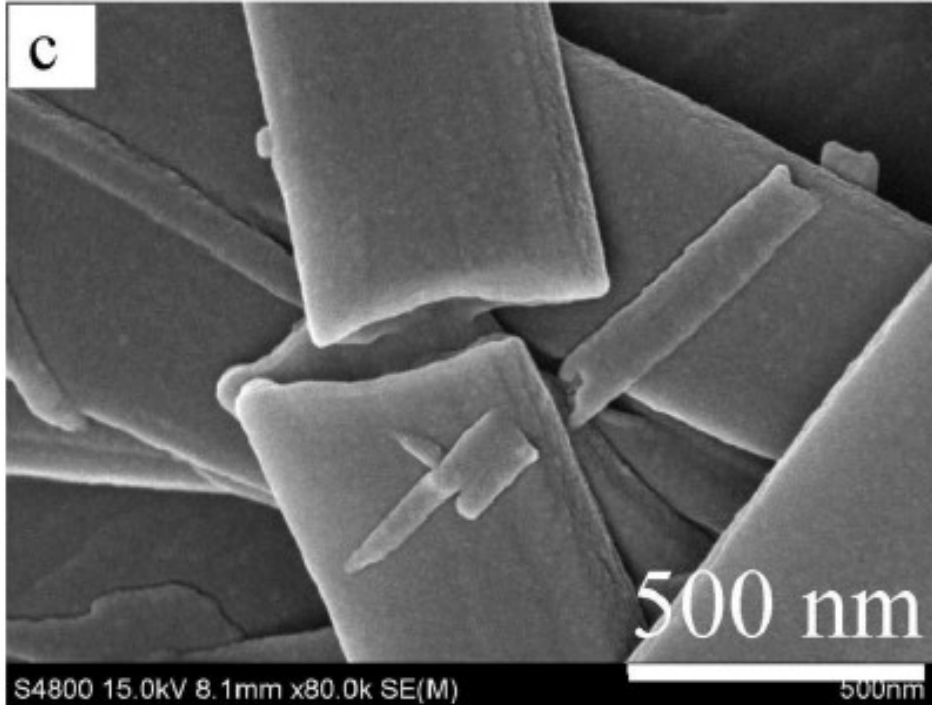
- Temperature influence (40 °C)



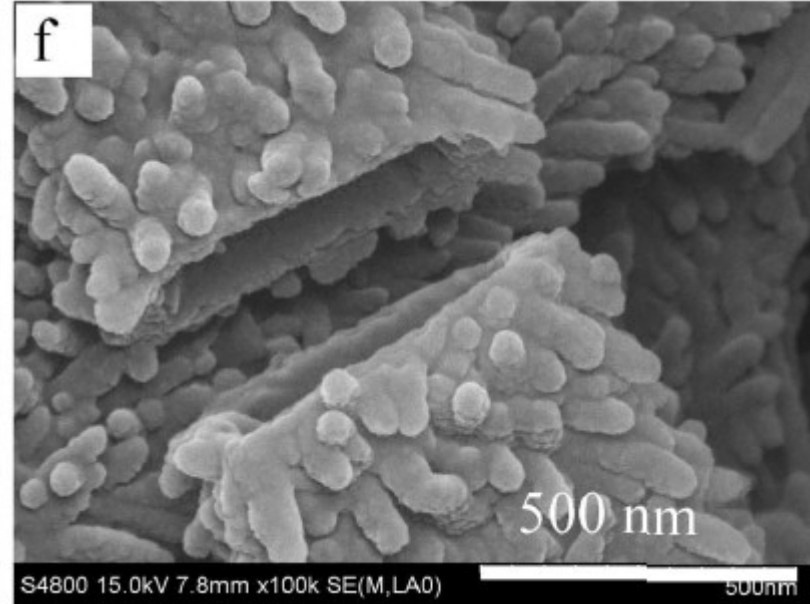
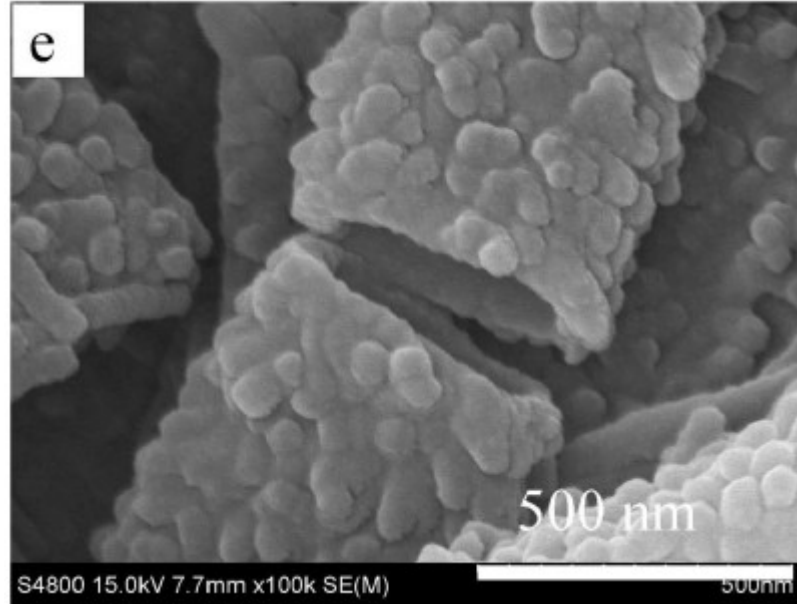
- Time reaction (a) 15 min; b) 30 min)



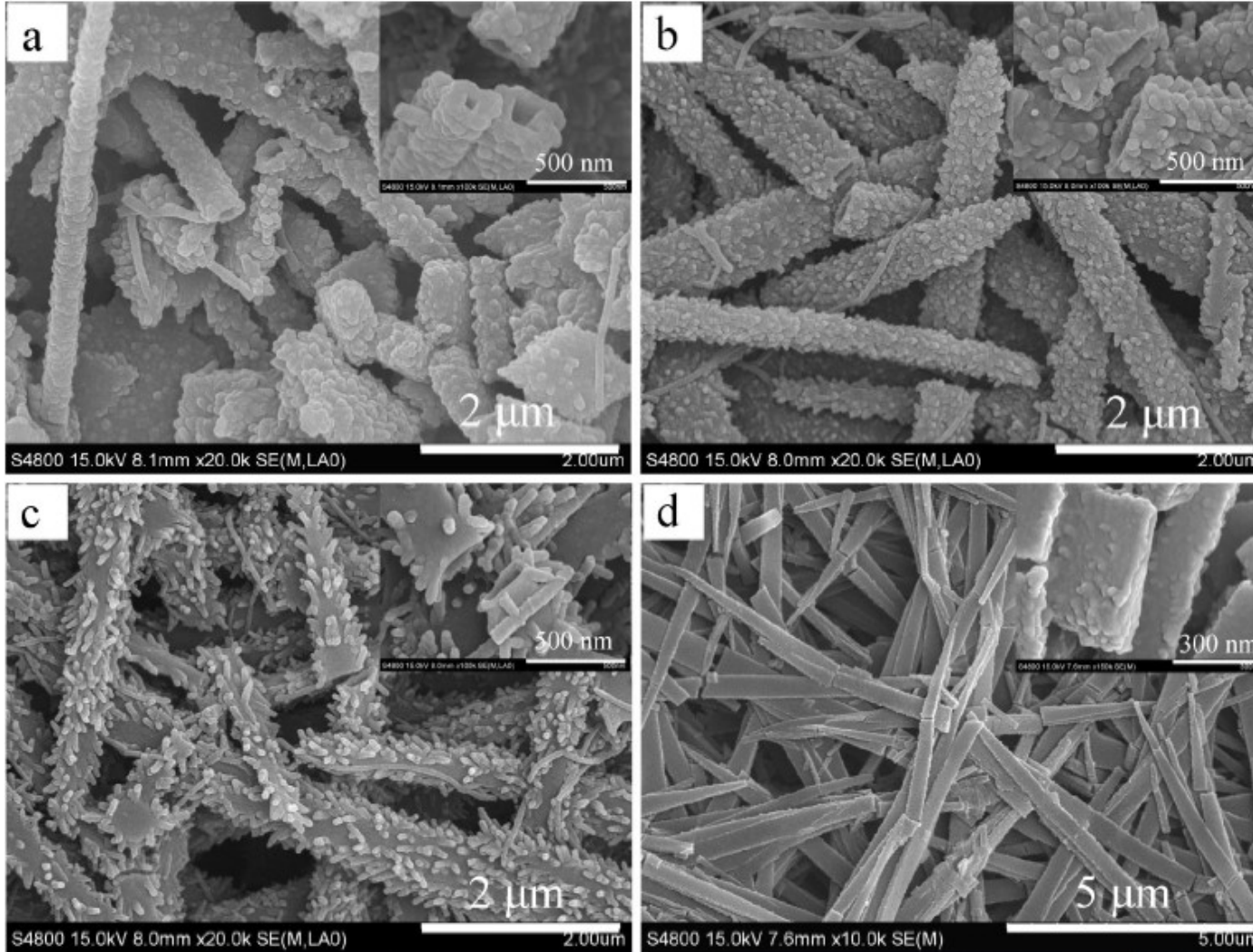
- Time reaction (c) 1 hour; d) 2 hour)



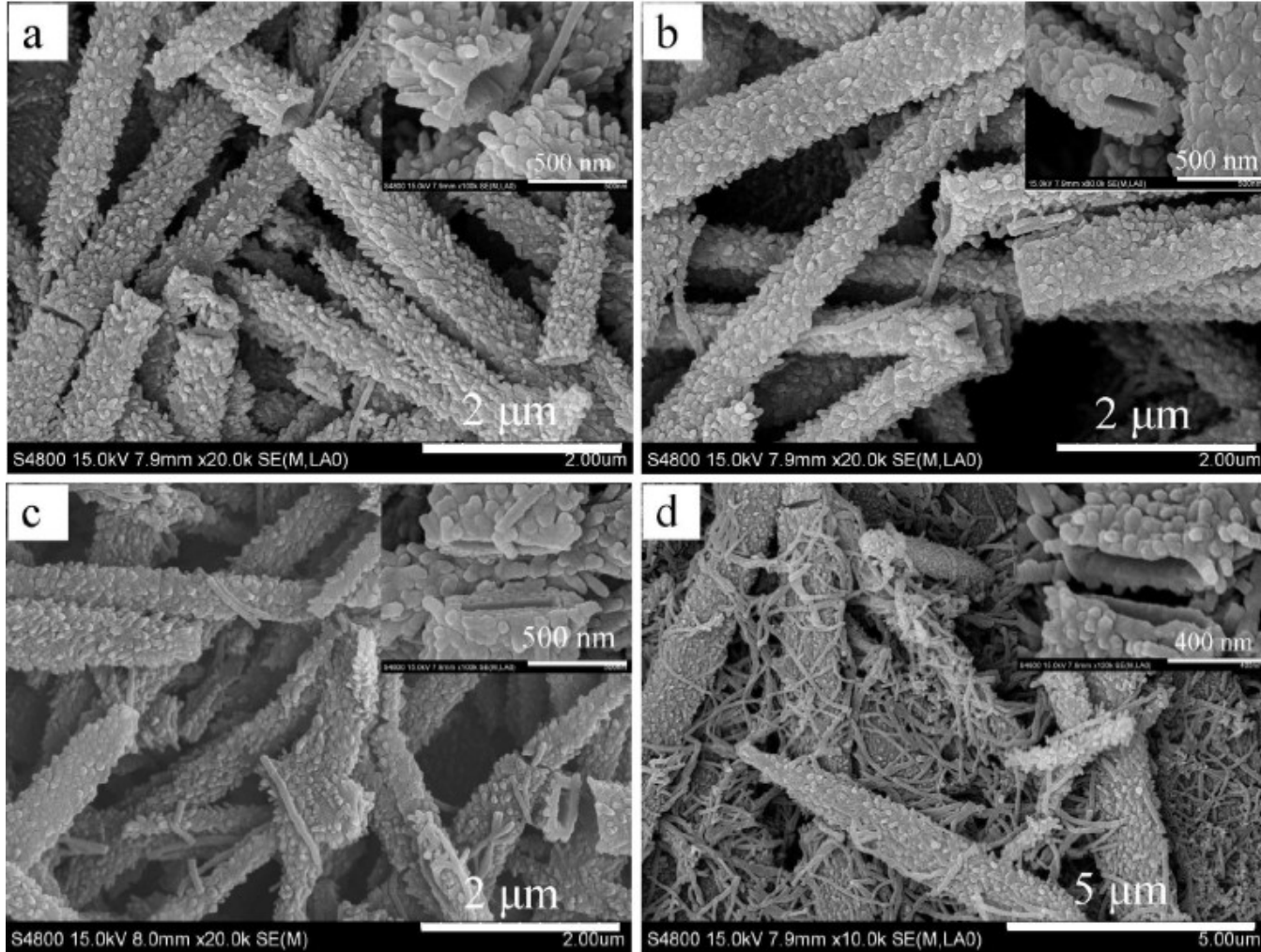
- Time reaction (e) 3 hour; f) 4 hour)



- Surfactant influence (a) 0.20 mM; b) 0.53 mM; c) 0.88 mM; d) 1.27 mM).

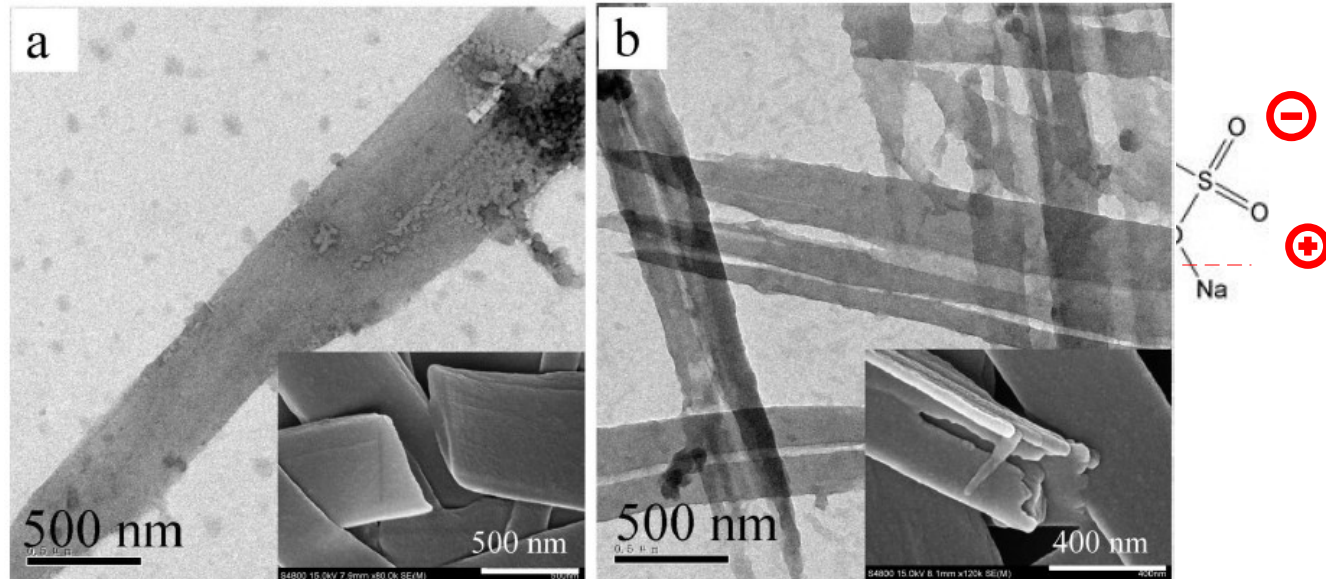


- Acid concentration influence (a) 0.075 mM; b) 1.15 mM; c) 2.5 mM; d) 5.25 mM



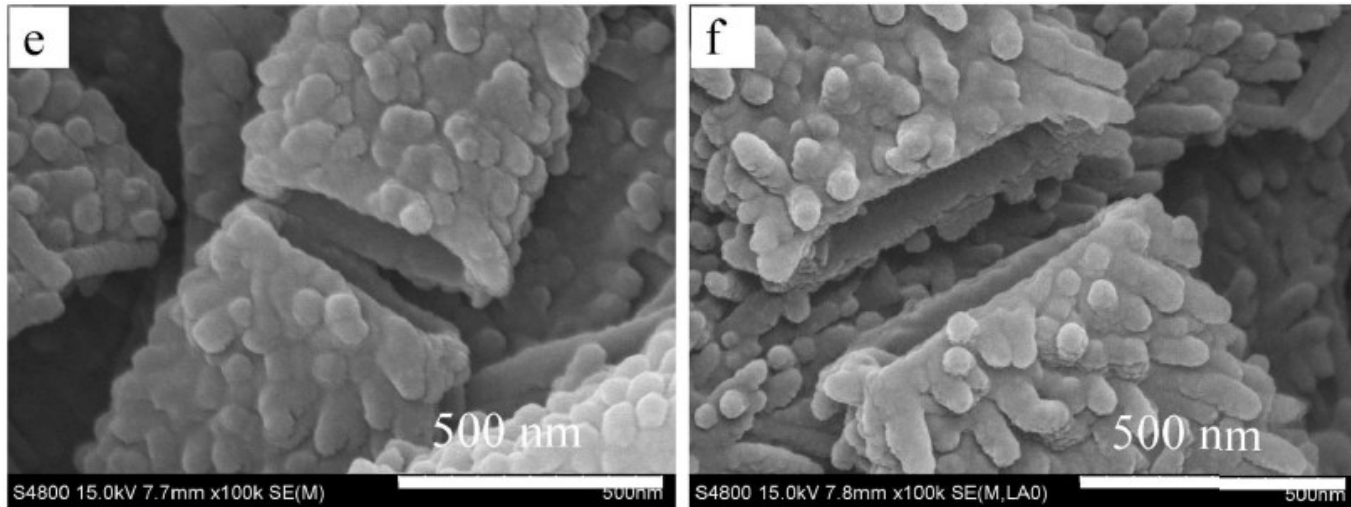
Interpretation of the interaction

- SDS molecules will interact with the cationic monomers and form a supramolecular structure.
 - This structure will connect with another form then beltlike.



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- SDS molecules will interact with the cationic monomers and form a supramolecular structure.
 - This structure will connect with another form then beltlike.



- If in solution has less surfactant.

Conclusions

- Rectangular submicrotubes of PANi have been successfully fabricated by polymerization reaction.
- It was found that the reaction temperature, time, surfactant concentration and acid concentration had profound impacts on the morphology and size of PANi nanomaterials.

Thank you