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Intelligent Textile with Doped Polyaniline

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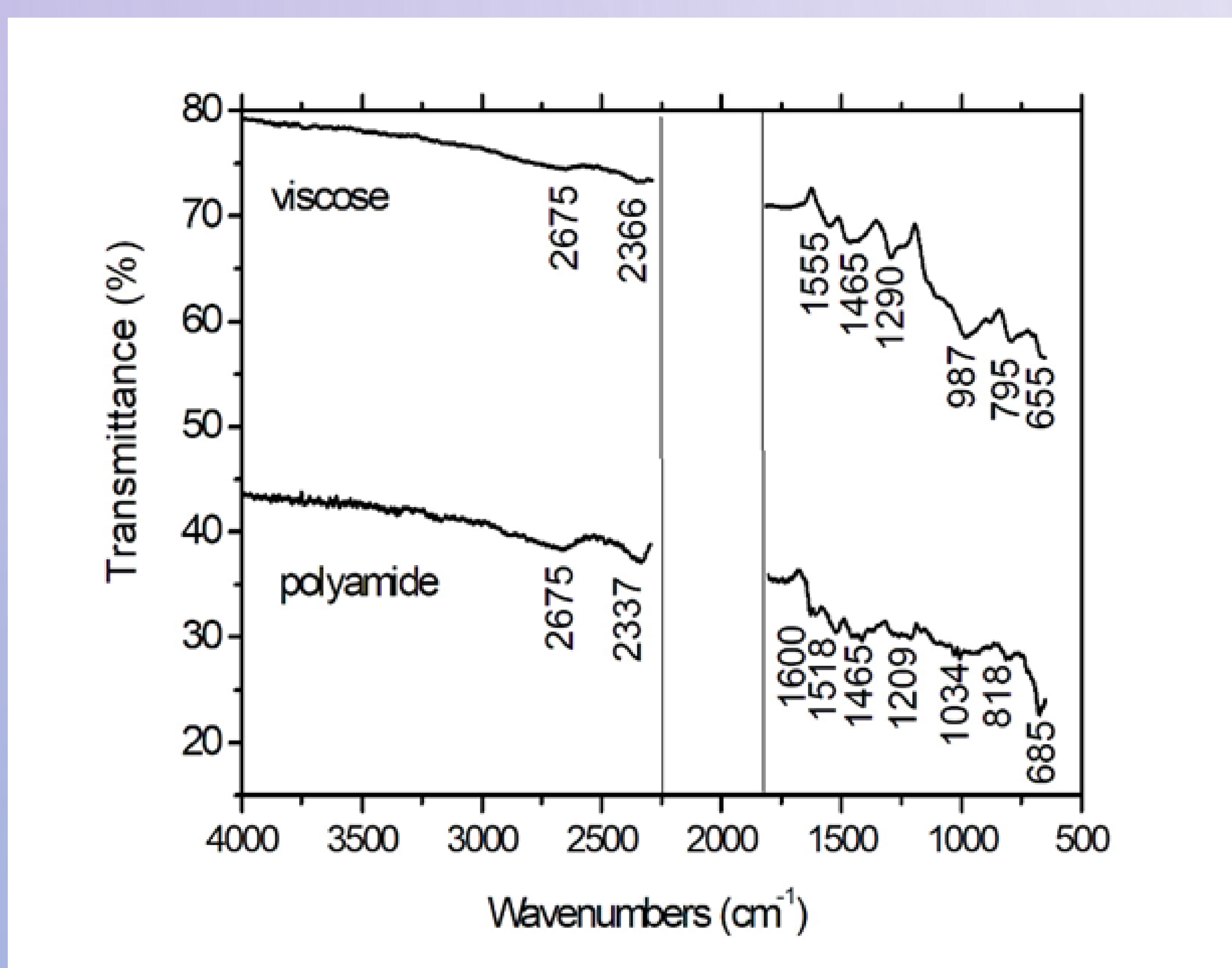
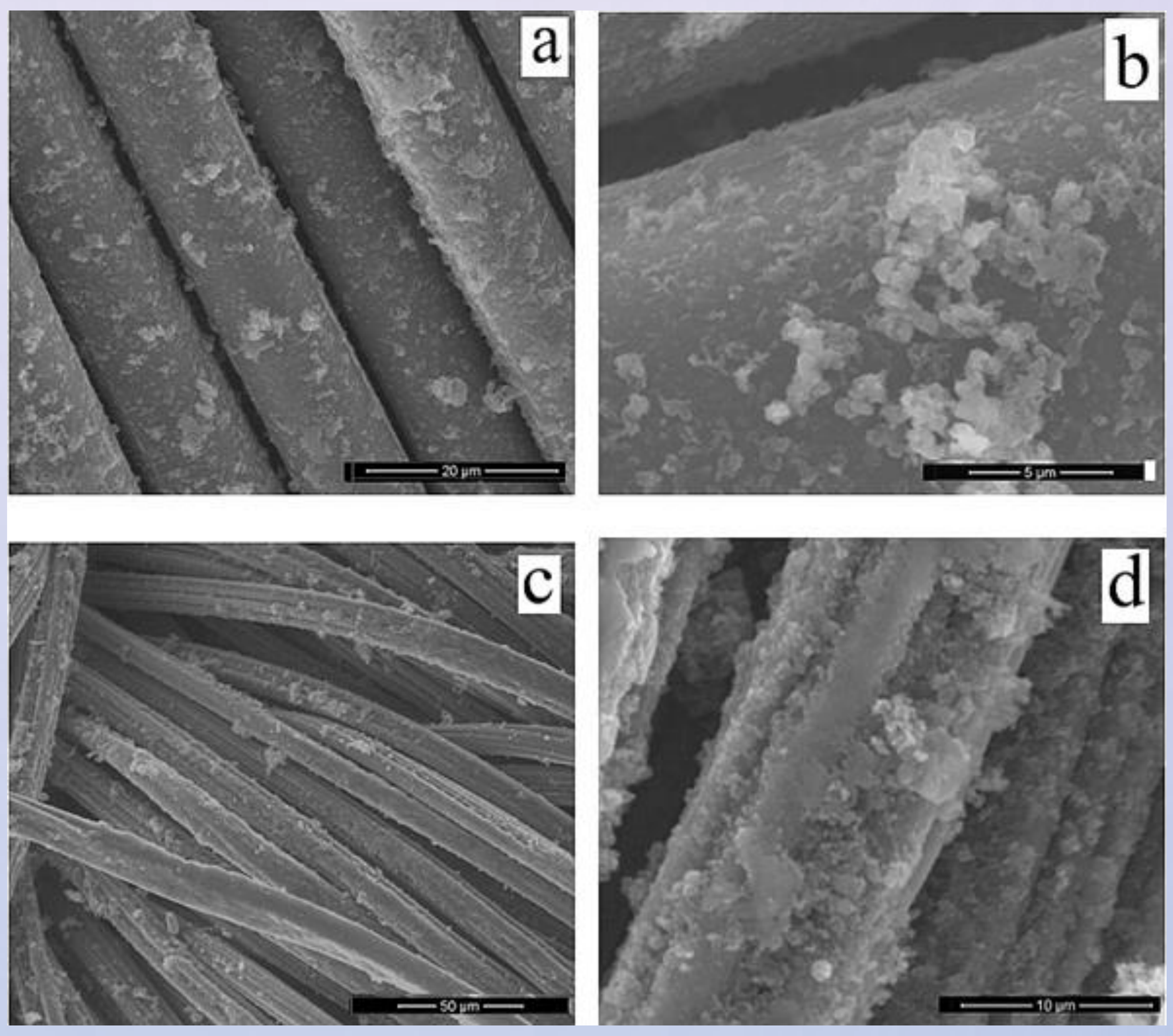
Summary: Intelligent textiles were obtained by "in situ" polymerization of aniline on viscose and polyamide as flexible substrates. Intelligent textiles are materials with electrical, mechanical, and thermal properties that improve the quality of life. The wide range of electrical or optical properties, and good environmental stability of emeraldine base and salt form, make polyaniline (PANI) attractive for a variety of applications. The polyaniline was doped with p-toluene sulfonic acid by direct route. The structure of the coated textiles was characterized by Infrared Spectroscopy with Attenuated total reflectance (ATR) device. The morphologies of the obtained textiles were investigated by Scanning Electron Microscopy (SEM). Viscose and polyamide textiles were coated uniform and showed good electrical properties. After coating with doped polyaniline, electrical properties of textile materials increased by 10^8 times. The best results were obtained for viscose.

Synthesis procedure: Textile materials were immersed in an aqueous mixture of 0.24 M aniline 99.5 and 0.48 M para-toluene sulfonic acid (p-TSA) 99% at temperature between 0 and 10ºC. Above was dropped time to 30 minutes an aqueous solution of 0.3M ammonium persulfate ($(NH_4)_2S_2O_8$) 98%. After polymerization, materials were washed with distilled water and dried. The final molar ratio between reactants was aniline: pTSA: $(NH_4)_2S_2O_8$= 2:1.4:1. The covered viscose obtained by "in situ" polymerization was noted V-PANI-pTSA and the coated polyamide was noted P- PANI-pTSA.

Infrared spectroscopy



SEM images



a) P-PANI-pTSA, magnification x5000;
b) P-PANI-pTSA, magnification x15000;
c) V-PANI-pTSA, magnification x1300;
d) V-PANI-pTSA, magnification x10000.

Table 1. Main bands present in the spectra of coated textiles

Characteristic frequency	Textiles	
	P-PANI-pTSA	V-PANI-pTSA
Q: C=C stretching	1600 cm^{-1}	1555 cm^{-1}
	1518 cm^{-1}	
B: C=C stretching	1465 cm^{-1}	1465 cm^{-1}
C-N stretching	1298 cm^{-1}	1290 cm^{-1}
$C\text{-}N^{+}$ stretching	1209 (cm^{-1})	
C-H rocking	1034-1009 cm^{-1}	987 cm^{-1}
C-H wagging	818 cm^{-1}	795 cm^{-1}
	685 cm^{-1}	655 cm^{-1}

B= benzene ring; Q = quinoide form

Table 2. Electrical properties of PANI-p-TSA coated textiles

Textile substrat	Surface electrical resistivity (Ωcm) SR EN 1149-1:2006		Color / Aspect after coating
	Initial textile	Coated textile	
Polyamide	$1.2*10^{11}$	$8.3*10^{3}$	Green/Uniform covered
Viscose	$2.5*10^{10}$	$7.6*10^{2}$	Green/Uniform covered

Conclusion

Intelligent textiles were obtained by "in situ"polymerization and direct doping using a molar ratio aniline: oxidant: p-TSA =2:1.4:1.
Viscose and polyamide textiles were coated uniformly and have good electrical resistivity of 10^3 -10^2 Ωcm.
The resistivity of materials after coating was improved of 10^8 times. The best resistivity was obtained in case of viscose. They can be used as flexible materials for optoelectronic devices.
Elimination of re-doping process and one-step reaction can decrease the cost of fabrication due to organic acid utilization.