Carrier's mobility determination in PS/PANI films by the potential decay technique

D. Mezdour[1], S. Sahli[2], M. Tabellout[3]

[1] Laboratoire LEM, Université de Jijel, Algérie, [2] Laboratoire de microsystèmes et instrumentation, Université de Constantine1, Algérie

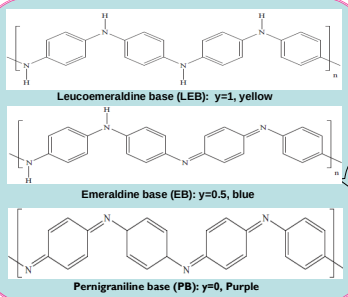
[3]IMMM-PEC, UMR CNRS 6283, Le Mans Université, France

Email : D_mezdour@mail.univ-jijel.dz

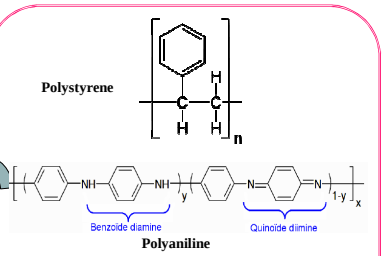
Abstract

Incorporation of conducting polymers into a host polymer forming a composite, or inter penetrated bulk network has been widely used in a manner to combine electrical conductivity with desirable physical properties of polymers. Polyaniline has attracted considerable interest as an air-stable conducting polymer. The present work deals with the investigation of the electrical properties of conducting composites based on polyaniline (PANI) and polystyrene (PS). The carrier's mobility as well as the surface conductivity are characterized by the potential decay technique where the surface of corona charged films is probed versus time.

Polyaniline

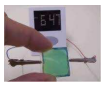


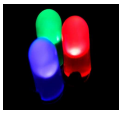
Materials

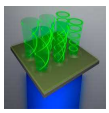


Applications

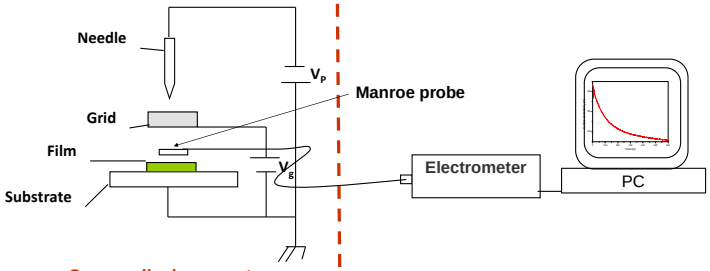
- Sensors and batteries
- LEDs, Transistors
- Organic Lasers
- Electromagnetic shielding
- Electrochromic coatings (Smart windows)



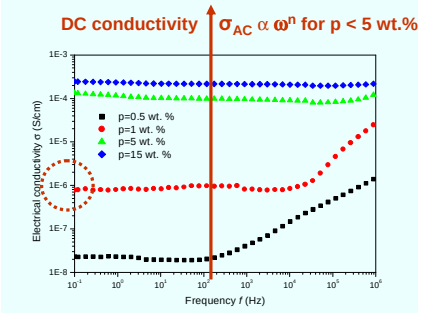




Surface potential decay technique (SPD)

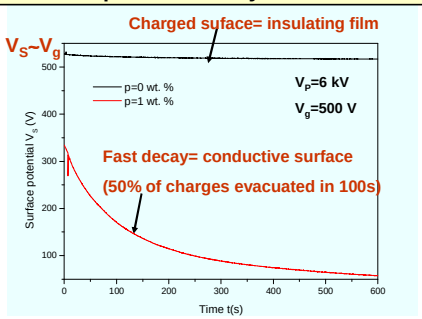


1- Bulk conductivity of PS/PANI powders



PANI percolation occurs at low concentrations(<1 wt.%)

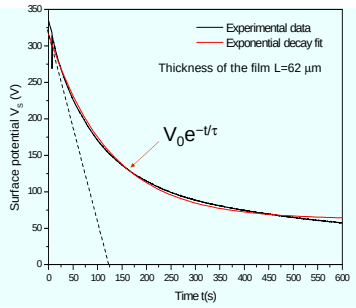
2- Surface potential decay of PS/PANI films



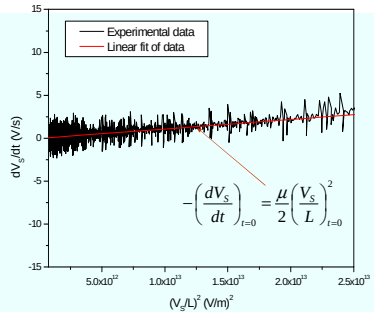
A little amount of PANI (1 wt.%) is sufficient to enhance the surface conductivity

3- Electrical parameters of a PS/PANI film (p=1 wt.%)

Determination of the decay time constant τ



Determination of carrier's mobility µ



$$\sigma_{DC} = \frac{\varepsilon_0 \varepsilon'}{\tau_{SPD}}$$

τ_{SPD} (s)	ε'	σ_{DC} (S cm^{-1})	µ (cm^2 V^{-1} s^{-1})
123.03	1.39x10^7	9.99x10^{-9}≈10^{-8}	2.2x10^{-9}

Conclusions

PS/PANI composite films with a good flexibility were prepared in dichloromethane using Sol-gel method. Conductivity measurement results support the formation of polyaniline salts:

⇒ σ_{DC} increases with the increasing concentration of PANI as verified by the decay potential technique.

⇒ The percolation threshold equals or is below 1 wt. % of PANI.

⇒ σ_{DC} (10^{-8} S cm^{-1}) of the film is two orders of magnitude lower than the one of the powder (10^{-6} S cm^{-1}) and is consistent with the calculated mobility (2.2x10^{-9} cm^2 V^{-1} s^{-1}). Such mobility is enhanced by PANI incorporation compared to a pure matrix as reported in the littérature.

⇒ σ_{DC} remains suitable for semiconductive and antistatic applications.