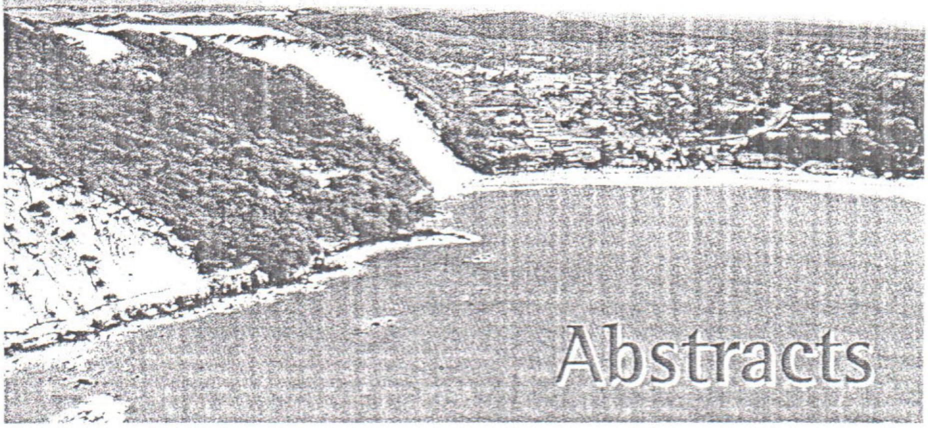
VI Encontro SBPMat 2007

28 out : 1 nov

SERHS GRAND HOTEL ★★★★★

NATAL



Abstracts

SPID 10826

6th Brazilian MRS Meeting
October 28th - November 1st

Evidence of Conducting Islands on Polyaniline films: Charge Nanocarriers

Leite, F. L. [(1,2)*], M. L. Simões [(1)], P. S. P. Herrmann[(2)], Martin Neto, L. [(2)], Mattoso, L. H. C. [(2)], and Oliveira, O. N. [(1)]

(1) Institute of Physics of São Carlos, University of São Paulo (USP), P. O. Box 369, São Carlos, 13560-970, SP, Brazil (leite@cnpdia.embrapa.br)
(2) National Nanotechnology Laboratory for Agriculture (LNNA), Embrapa Agricultural Instrumentation, P. O. Box 741, São Carlos, 13560-970, SP, Brazil.
* Corresponding author.

Abstract

Mapping forces with atomic force spectroscopy has allowed us to identify conducting islands surrounded by a less conductive matrix in poly(o-ethoxyaniline) (POEA) and parent polyaniline (PANI) films, with the conducting islands being characterized by the presence of double-layer forces. The conducting islands were further visualized via Transmission Electron Microscopy (TEM). At pH 3, POEA appeared completely doped where PANI preserved its conducting character, which was confirmed with electron paramagnetic resonance (EPR) measurements. Charge nanocarriers were detected only for low pH values indicating its metallic character.

Mechanisms of charge conduction in conducting polymers continue to be of increasing interest particularly with regard to producing electronic tongue and metal-insulator semiconducting devices [1]. It is also important to study charge carriers in thin films, whose properties depend on the micro-morphology. In PANI films, dopant molecules are not uniformly distributed but agglomerate in the form of dispersed conductive islands [2]. Therefore, these materials are believed to be composed of many essentially isolated metallic chains and electrons transport along the chains with interchain hopping as a necessary secondary step [3]. Here we studied the conducting regions in POEA films with Atomic Force Microscope TMX 2010 model SPM instrument, including special cantilevers with Si_3N_4 (0,032 N/m) tips and a fluid cell. Electron paramagnetic resonance (EPR) spectroscopy data were obtained with a Bruker EMX 300. All samples were analyzed under identical conditions: 5 mW microwave power, 0.1 mT modulation amplitude, microwave frequency of 9.49 GHz (X-band), and conversion time of 20 ns. Results from transmission electron microscopy (TEM) were obtained with a Philips CM 120. Fig. 1a shows a TEM picture pointing to a rearrangement of macromolecules during the doping process and the appearance of conducting islands. These appear as small black islands (diameter: 5.2 -11.5 nm) in a less dense matrix. The inter-particle distance of the islands is within the range between 1.9 and 6.2 nm, with an average value of 4.0 nm. Atomic force spectroscopy was used to map adhesion forces, with islands of ca. 15 nm in diameter appearing in Fig. 1b. Taken together, these data represent a clear proof of conducting islands on polyanilines.

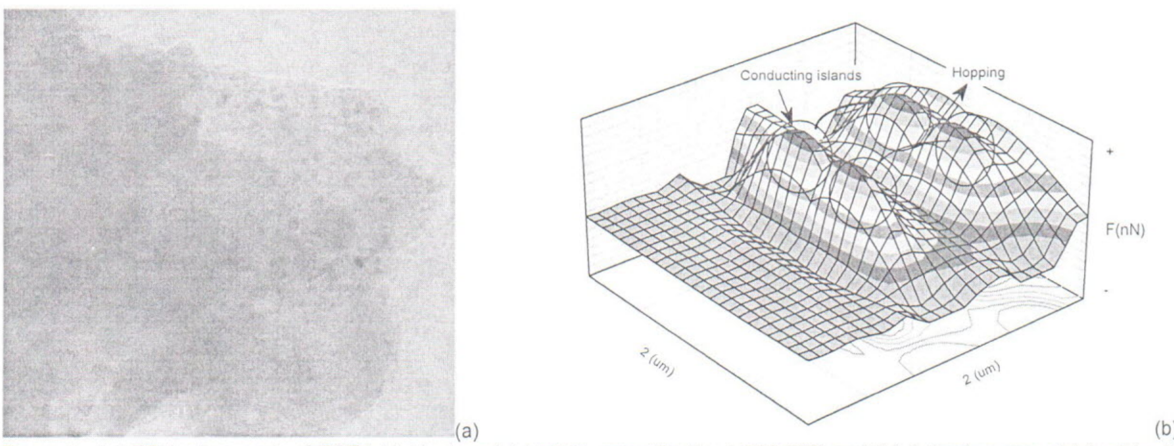


Figure 1. (a) TEM micrograph of POEA highly doped (pH=3.0), magnification (x100.000) and (b) Adhesion map obtained by AFS on POEA films in solution (pH=3.0). The charge nanocarriers hopping occur between two nearer conducting islands.

References

[1] Borato, C. E. Riul, A., Ferreira, M., Oliveira Jr, O. N., Mattoso, L. H. C., Instr. Sci. Tech. 32 (2004), 21.
[2] D. Jeon, J. Kim, M. C. Gallagher and R. F. Willis, Science 256 (1992), 5064.
[3] Z. H. Wang, E. M. Scherr, A. G. MacDiarmid, A. J. Epstein, Phys. Rev. B 45 (1992), 4190.