Materials Science in Semiconductor Processing 30 (2015) 494–501

Contents lists available at ScienceDirect

Materials Science in Semiconductor Processing

journal homepage: www.elsevier.com/locate/mssp

Short Communication

# Comparative study of pure polyaniline with various oxidants by a template free method

S. Ashokan [a], V. Ponnuswamy [a,*], P. Jayamurugan [a,b]

[a] Department of Physics, Sri Ramakrishna Mission Vidyalaya College of Arts and Science, Coimbatore, Tamil Nadu, India
[b] Department of Physics, Adhiyamaan College of Engineering, Hosur, Tamil Nadu, India

ARTICLE INFO

Available online 19 November 2014

*Keywords:*
Various oxidants
Template free method
Photoconductivity response
Photoluminescence

ABSTRACT

Polyaniline was successfully synthesized by a template-free method using APS (Ammonium peroxydisulfate), $K_2Cr_2O_7$ (Potassium dichromate) and $FeCl_3$ (Ferric Chloride) as oxidizers. The samples were characterized by structural, optical, morphological and electrical studies. The SEM images show the presence of spherical and flower-shaped particles with uniform size distribution. Optical studies indicate the presence of an absorption band around 285–350 nm due to $\pi$–$\pi^*$ electronic transition in the benzene rings of the polymer backbone. The calculated band gap energy is found to vary 2.3–2.7 eV for the different oxidants used. The FT-IR spectrum confirms the presence of formational groups of PANI. XRD studies were also taken for the synthesized PANI. Photoluminescence studies reveal the direct band gap energy variation between 3.18 and 3.86 eV. Electrical studies exhibit the positive photoconductivity nature of the PANI samples. The maximum conductivity is observed for the PANI prepared with APS in the aqueous medium. The dielectric constant is very high at low frequency range and becomes stable at higher frequency.



## 1. Introduction

Polyaniline is one of the most promising conducting polymers with enhanced conductivity, good environmental stability, easy doping control and diverse color changes corresponding to oxidation levels [1]. Much research has focused on the influence of the polymerizing conditions on the general properties of conducting polymer (chemical, electrochemical, physical, electrical, mechanical, and morphological characteristics).

Recently, a simplified template-free method was proposed to synthesize PANI nanostructures. It can be easily doped upon exposure to a protonic acid and become electrically conductive.

In particular, polyaniline and its derivatives are intrinsically conducting polymers that have been extensively studied during the last twenty years because of their environmental stability (air, moisture), good process ability and their relatively low cost [2,3].

Photoluminescent conducting polymers have attracted much attention because of their potential applications in biosensors [4–9].

In our previous work, we have reported a comparison of the optical property of polyaniline using various dopants by a chemical oxidation method [10]. There are only a few reports concerning photoluminescent and photoconductivity of polyaniline. In this present work, our aim was to make a comparative study among the three oxidants by investigating their photoconductivity

* Corresponding author: Tel.: +91 422 2692461; fax: +91 422 2693812.
*E-mail address:* ashopudur@yahoo.com (V. Ponnuswamy).

http://dx.doi.org/10.1016/j.mssp.2014.09.046
1369-8001/

and photoluminescence properties in polyaniline by the template-free method.

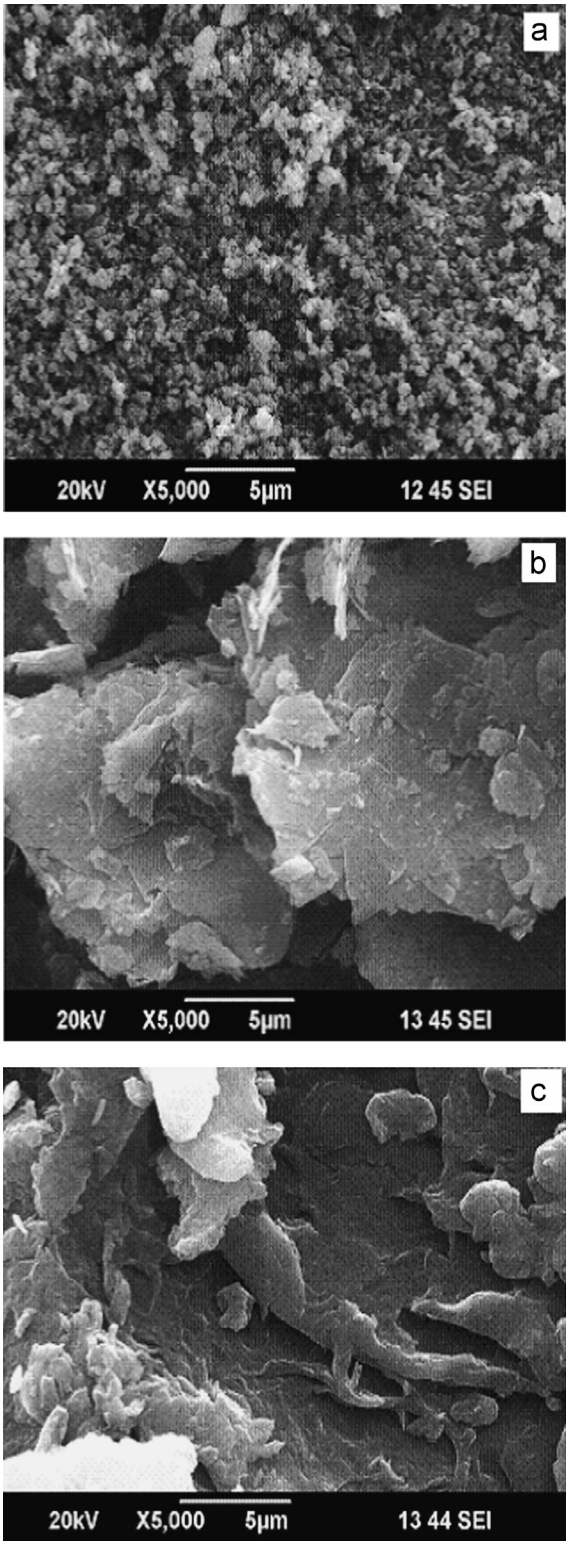


**Fig. 1.** SEM images of (a) APS doped PANI, (b) $K_2Cr_2O_7$ doped PANI and (c) $FeCl_3$ doped PANI.

## 2. Experimental methods

### 2.1. Materials

Aniline monomer (Sigma-Alridch, India) was purified by using distillation plant and the oxidants APS (Ammonium peroxydisulfate), $K_2Cr_2O_7$ (Potassium dichromate), $FeCl_3$ (Ferric Chloride), methanol, and acetone (Merck) were purchased for synthesis and used as such.

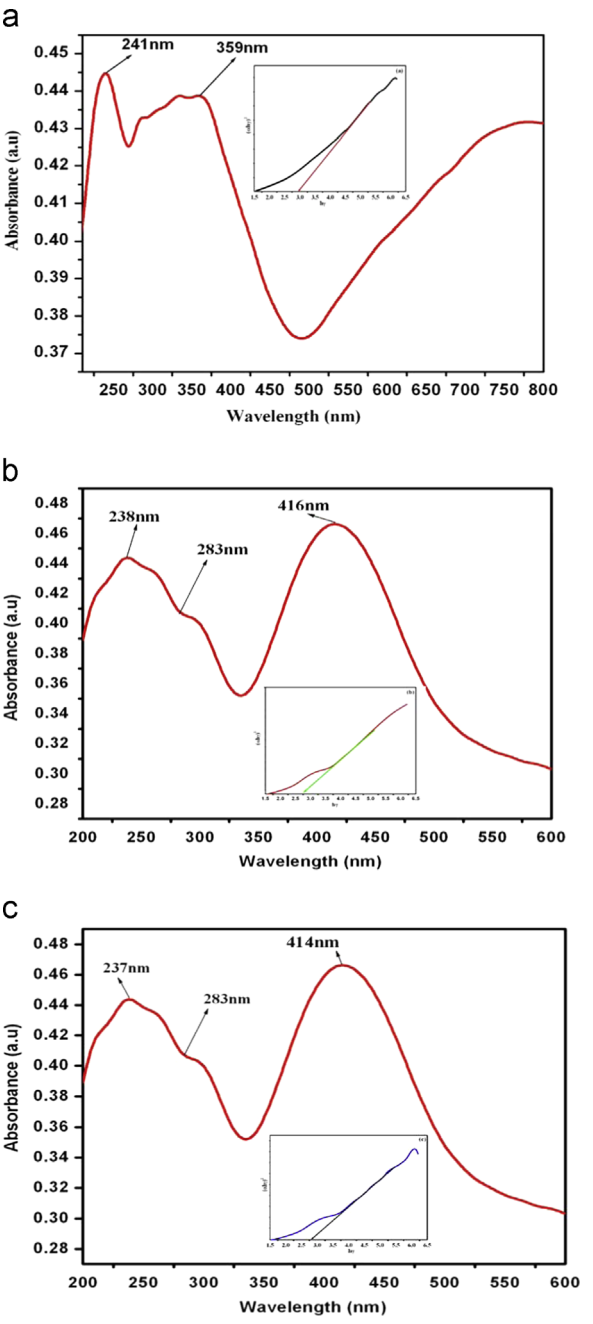


**Fig. 2.** UV-spectra of (a) APS, (b) $K_2Cr_2O_7$ and (c) $FeCl_3$ doped PANI (inset shows band gap energy).