

## The Optical Properties of Polyaniline Blend With Poly-Methal-Methacrylate as Conducting Polymers Alloys (PAni/PMMA)

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### Abstract

Conducting polymer blends (PAni/PMMA) has been prepared by chemical polymerization method. Thin films of these blends were prepared by casting method with different ratios of PAni. The weight ratios of PAni were 10%, 20%, 30%, 40%, 50%, and 60%. The blends were doped in sulfuric acid with different concentrations. The optical properties were studied for each ratio of mixture. The optical analyses indicated that the transition was indirect transition. All these results were discussed.

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. .%60 ,%50,%40,%30,%20,%10 .

### Introduction:

The twentieth century witness a major change in the human life style due to the revolutionary discoveries and developments in the field of polymer science and engineering. There is a long history of successful development, which came from the enormous contributions of numerous people(A.J. Heeger& Angew 2001,Hua & Gaoquan2007).

Due to its ease of synthesis and processing, environmental stability, relatively high conductivity and cost economics, polyaniline is probably the most industrially important conducting polymer today(H. Shirakawa et al 1977 , A.G. MacDiarmid et al 2001, C.K. Chiang et al 1986).

Polyaniline (PAni) is an organic conducting polymer that was first reported in the literature about 100 years ago. However, recently , there has been a surge in research on polyaniline since it was shown that its conductivity could be increased by more than ten orders of magnitude by doping them with proton acids ( C. Chiang and A. G. MacDiarmid1986) .

A transparent conductive polymer blends possesses the unique properties of good electrical conductivity and high optical transparency in UV visible spectrum (V. Sreejith 2004).

The optical properties of (PAni) with PMMA blend are improved by doping with acidic protons. The investigations of PAni/PMMA are interesting because of their wide range of applications; (i) transparent-conductive material on bulk semiconductors show considerable promise for use in inexpensive solar cell, (ii) the refractive index of PAni/PMMA are in the right range so as to form an antireflection with other semiconductors. In the present work PAni/PMMA blends were prepared using casting technique. In this technique the blends were doped with sulfuric acid. The optical properties were studied with various PAni concentrations.

### Experimental

Polyaniline was synthesized by the oxidative polymerization of aniline in acidic media, using a method similar to that reported by (León 2001). The blends of (PAni/PMMA) were prepared by the casting polymerization method. 5g of PMMA was dissolved in 10ml of pure distilled acetone solution. In order to avoid habitation of bubbles, process was made in low temperature medium and continuous movement.

The solution of PAni added on the PMMA solution as drops with moving stirrer. The last process was dropping the mixture on broad dish of glass and leaved to dry for 24 hours. The weight ratios of PAni were 10%, 20%, 30%, 40%, 50%, and 60%.

The blends were transparent and their colors graduated from light yellow to brown, depending on the ratio of PAni. Each ratio of PAni blend was immersed in H<sub>2</sub>SO<sub>4</sub> acid for 24 hour. The concentration of H<sub>2</sub>SO<sub>4</sub> varied from 5% to 60%. The properties of absorption and transmittance before and after doping were studied at the range (200-600 nm) using the (UV) spectro-photometer. The measurements were adopted at room temperature and to be analyzed and discussed.

### Results and Discussion

The absorption coefficients ( $\alpha$ ) have been estimated after correction for the reflection losses. The absorption coefficient is given by (Ziadan et al 1998):

$$\alpha = \left( \frac{2.303}{d} \right) * A' \quad \dots\dots\dots 1$$

where  $d$  is the thickness of the sample and  $A'$  is the absorption after correction which can be estimated as:

$$A' = A - A^0 \quad \dots\dots\dots 2$$

where  $A$  is the absorbance and  $A^0$  is the correction for the reflection.

Figure 1 shows the absorption coefficient versus photon energy of PAni/PMMA blends at different concentrations of PAni. The absorption coefficient data were analyzed for evidence of inter band transition in the fundamental absorption region. The optical absorption data of PAni/PMMA, in the low absorption region  $\alpha < 10^4 \text{ cm}^{-1}$ , were analyzed to obtain information on the non-vertical allowed transition in frame of the theory of (Bardeen et al 1956).

$$\alpha = \frac{A(h\nu - E_g \pm E_p)^2}{h\nu} \quad \dots\dots\dots 3$$

Where  $E_g$  is the indirect band gap and  $E_p$  is the energy of the absorbed (+) or emitted phonons. Figure (2) shows  $(\alpha h\nu)^{1/2}$  versus  $h\nu$ , each curve contained two different slopes give two straight lines. The lower energy line corresponds to

absorption transition processes and photon energy intercept at  $E_g - E_p$ . The other line corresponds to phonon emission process and the photon intercept at  $E_g + E_p$ . Table 1 shows  $E_g$  and  $E_p$  for different ratios of PAni/PMMA concentrations. It clear that the increase in PAni ratio causes lowering in the energy gap which means a rising in conductivity. Figure (3) shows  $(\alpha h\nu)^{1/2}$  versus  $h\nu$ , for 50%PAni/PMMA doped with different concentration of  $H_2SO_4$ . This Figure indetectes the effect of patronization with  $H_2SO_4$  on PAni/PMMA. The energy gap decreased with increasing  $H_2SO_4$ . The indirect allowed energy gap and assisting phonon energy are tabulated in Table 2. The phonon energy for different specimens is too high to be considered as lattice phonon (Hanna et al (1992)).

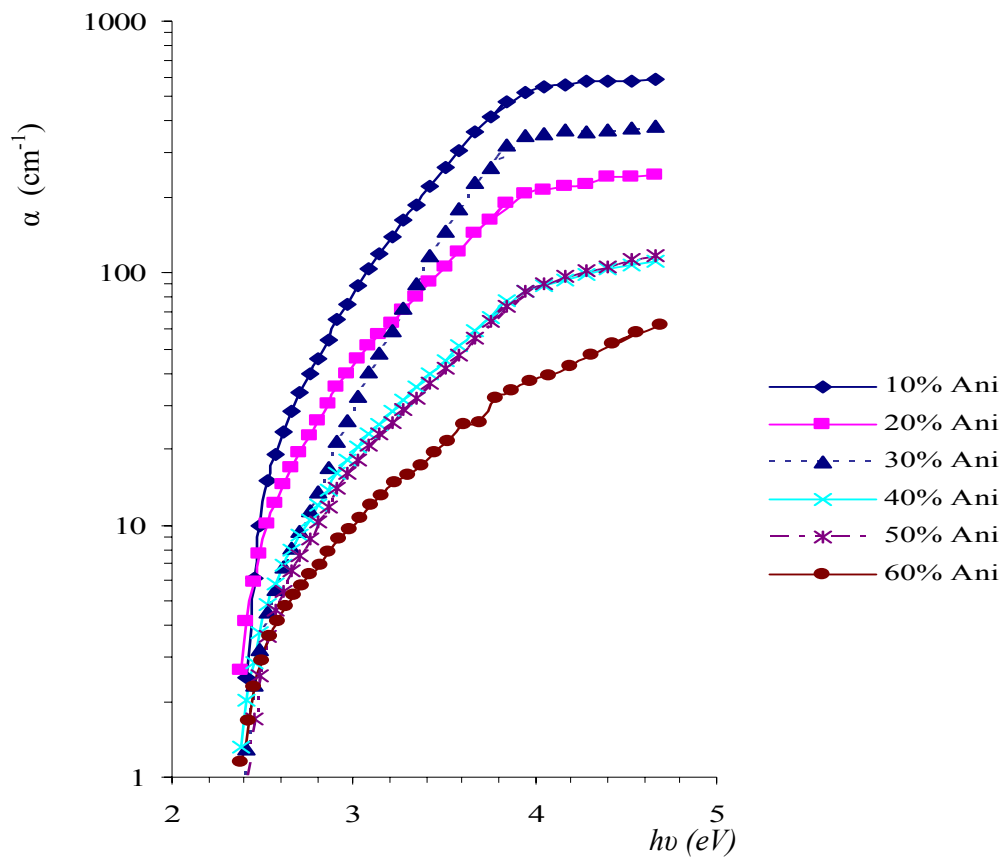


Figure 1 Absorption coefficient versus photon energy of deferent concentration of PAni.

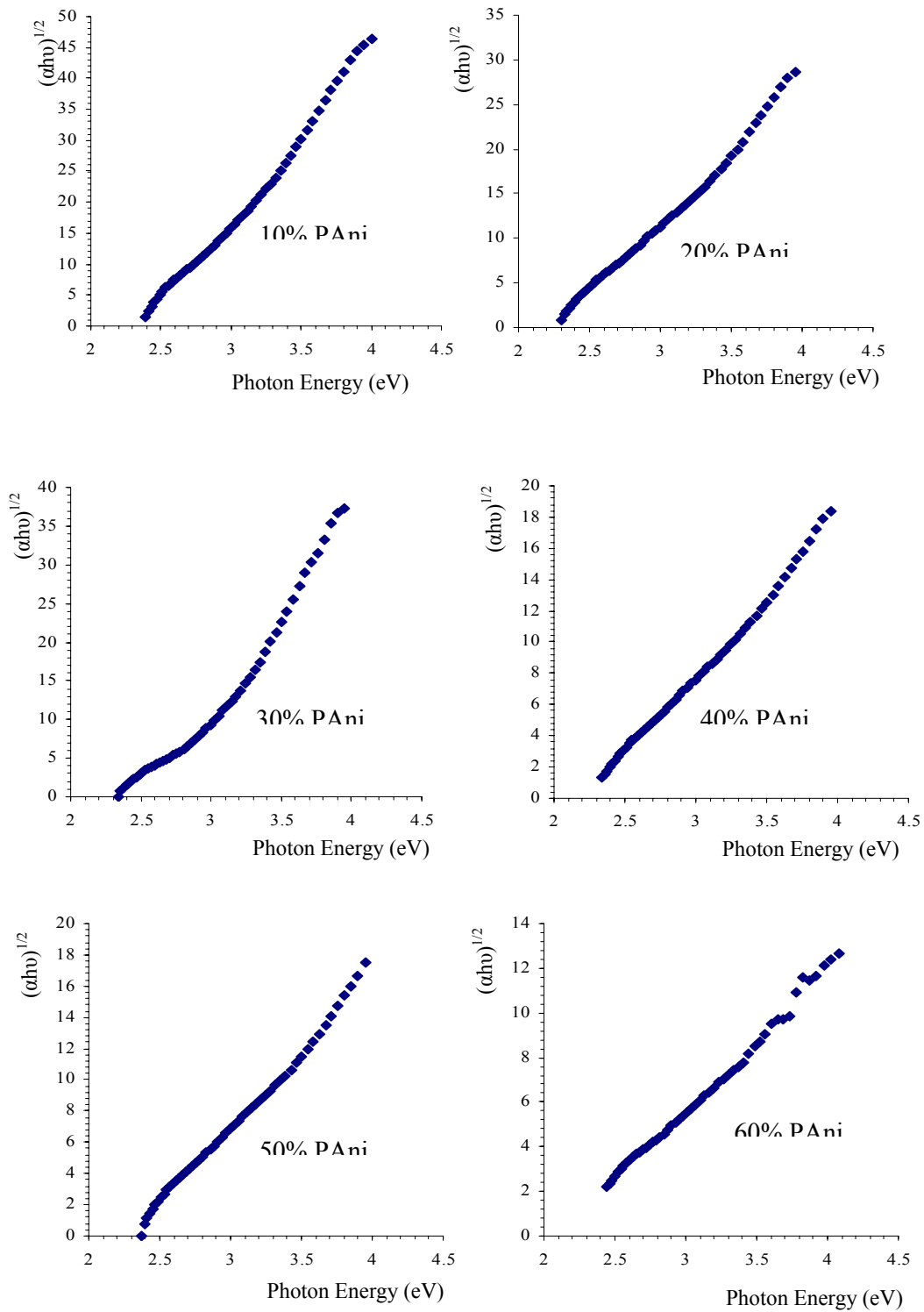


Figure (2)  $(\alpha h\nu)^{1/2}$  as a function of  $h\nu$  of different ratio of PANi

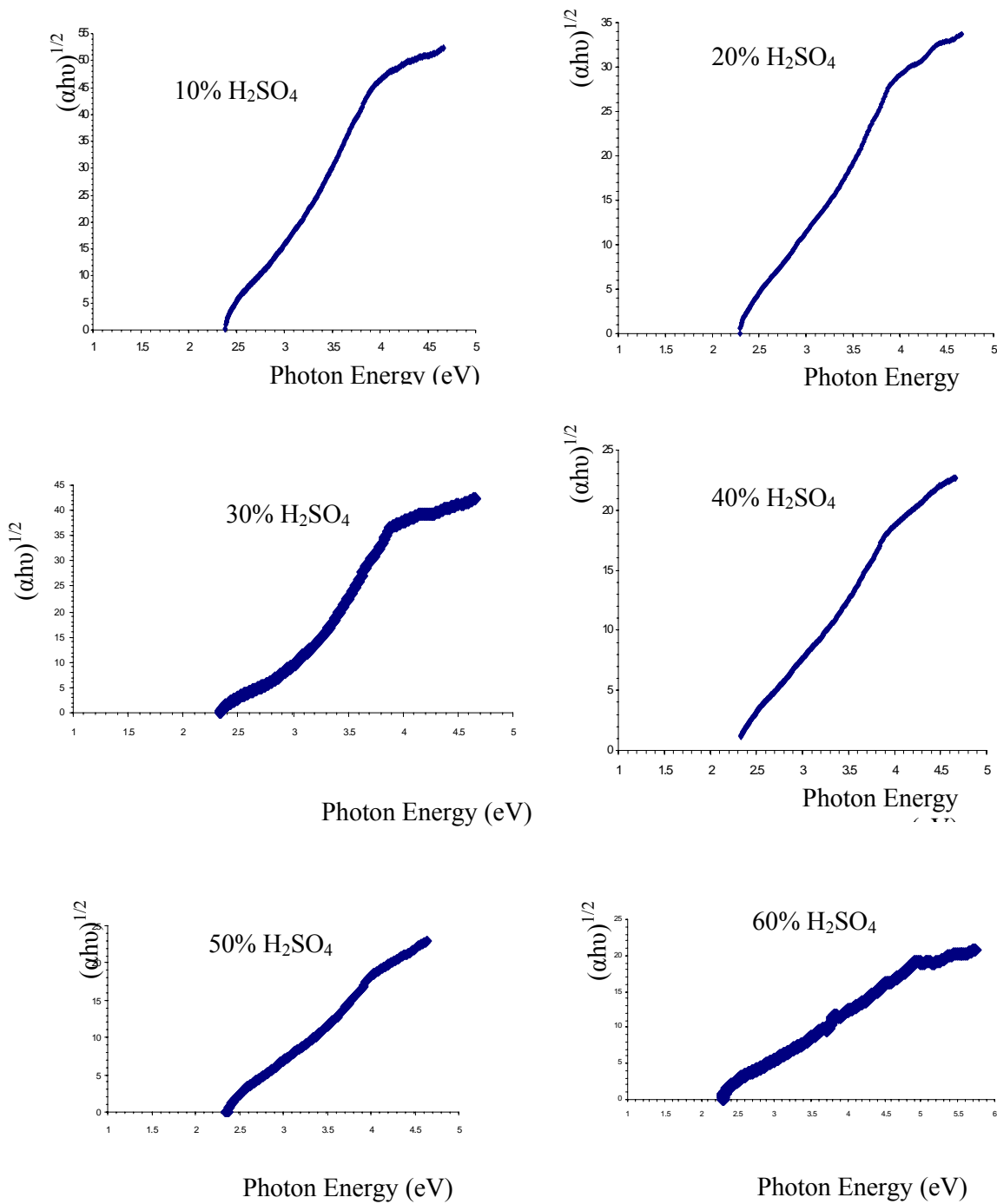


Figure 3  $(\alpha h\nu)^{1/2}$  as a function of  $h\nu$  for 50% PANi/PMMA doped with different concentration of  $H_2SO_4$ .

Table 1 The phonon energy and energy gap of different ratio of PANi/PMMA.

Concentration of PANi	$E_g$ (eV)	$E_p$ (eV)
0%	3.42	0.42
10%	3.215	0.19
20%	3.175	0.25
30%	3.02	0.28
40%	2.65	0.5
50%	2.9	0.27
60%	1.53	0.28

Table 2 The phonon energy and energy gap of 50% PANi /PMMA doped with different ratio of  $H_2SO_4$ .

Concentration of PANi	$E_g$ (eV)	$E_p$ (eV)
10%	2.93	0.22
20%	2.74	0.49
30%	2.29	0.17
40%	2.11	0.24
50%	2.15	0.15
60%	2.4	0.15

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