Electronic supplementary information

Agarose-guar gum assisted synthesis of processable polyaniline composite: morphology and electro-responsive characteristics

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The effect of aniline to oxidant molar ratio on the composite conductivity was studied by varying potassium dichromate concentration, to achieve different aniline to potassium dichromate ratios (1 to 8) at a fixed concentration of HCl (1M) and aniline monomer (0.4M). It indicates that the conductivity of A-G-PANI composite films vary by three orders of magnitude in the range of $1.48\pm0.3\times10^{-5}$S/cm to $1.10\pm 0.3\times10^{-2}$ S/cm, showing maximum conductivity of $5.8\pm0.2\times10^{-2}$S/cm at 5 molar ratio (Fig. 1Sa). These results are in agreement with the previous report, where polyaniline synthesis was done under similar conditions using potassium dichromate as an oxidant.[16] Above findings can be explained as follows, at a lower A:O molar ratio (5), higher concentration of oxidant may have produced low molecular weight oxidative products, which was clearly observed by brown coloration of the films. While at a higher molar ratio (6 and 8), lower concentration of oxidant may have caused incomplete conversion of aniline to polyaniline in the composite, thereby lowering the conductivity of A-G-PANI composite films.

Proper concentration of acid is required to achieve the essential ionic environment for head to tail coupling of aniline, and further for the subsequent polyaniline salt formation.[6] The influence of HCl concentration on the synthesis of A-G-PANI composite was studied at a fixed A:O molar ratio (5), and aniline monomer concentration (0.4M). It was observed that the conductivity of A-G-PANI films vary from $1.16\pm0.6\times10^{-5}$S/cm to $3.59\pm\times1.710^{-3}$S/cm, having highest conductivity of $6.16\pm2\times10^{-2}$S/cm at 1 M HCl concentration (Fig. 1Sb). Lower concentration of HCl(0.5 M) was found to insufficient for a polymerization while at higher concentration of acid may cause partial hydrolysis of the biopolymer, thus leading lower conductivity of A-G_PANI composite. Therefore, it can be concluded that, aniline: potassium dichromate molar ratio of 5 and 1M HCl concentration is suitable for the synthesis of A-G-PANI composite with highest conductivity value.

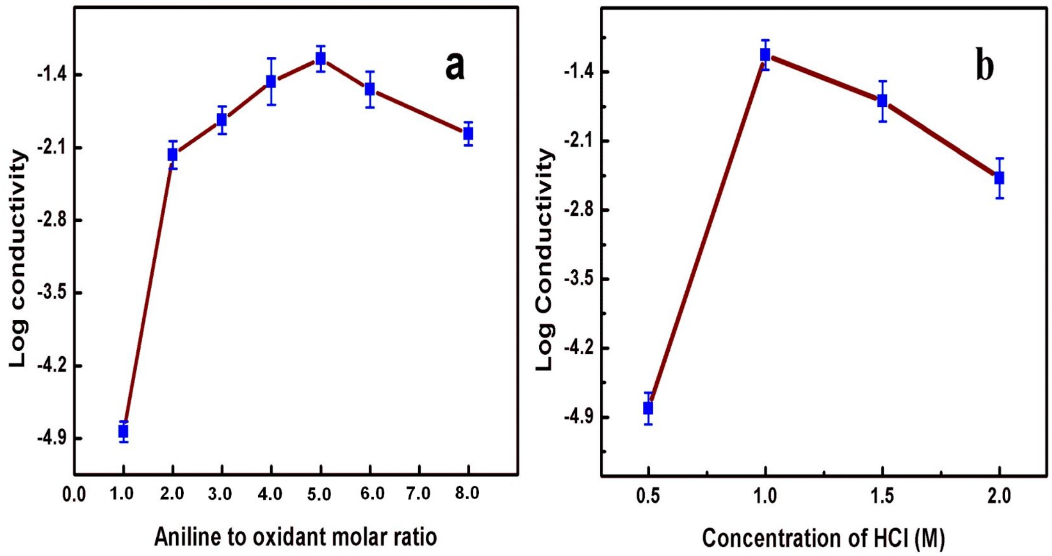

Fig. S1. Effect of varying (a) aniline:oxidant molar ratio (b) HCl concentration on the conductivity of A-G-PANI films.

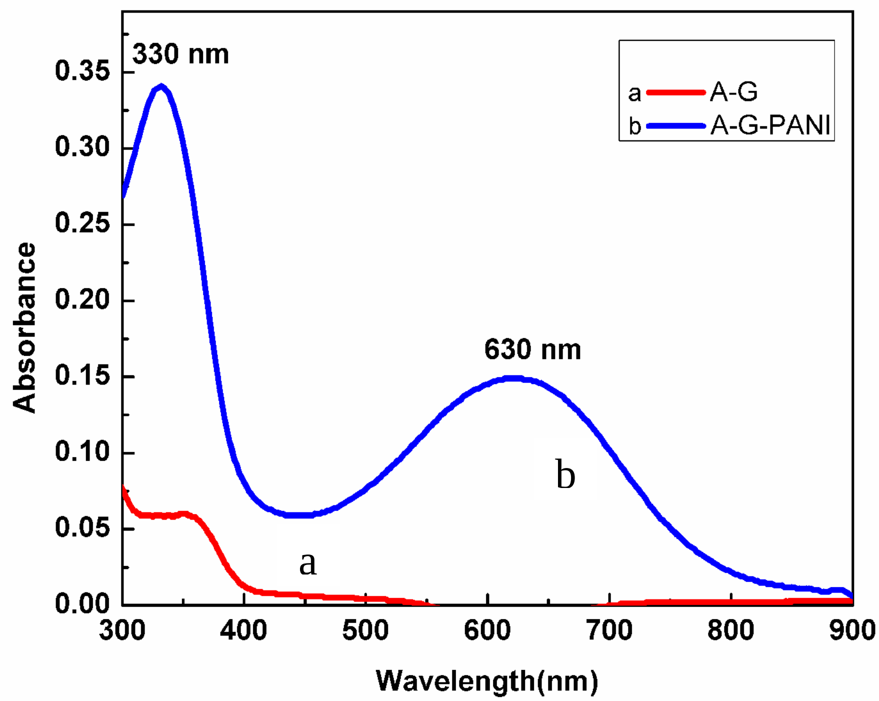

Fig. S2. UV-Visible spectra of (a) A-G film and (b) A-G-PANI composite film in DMSO

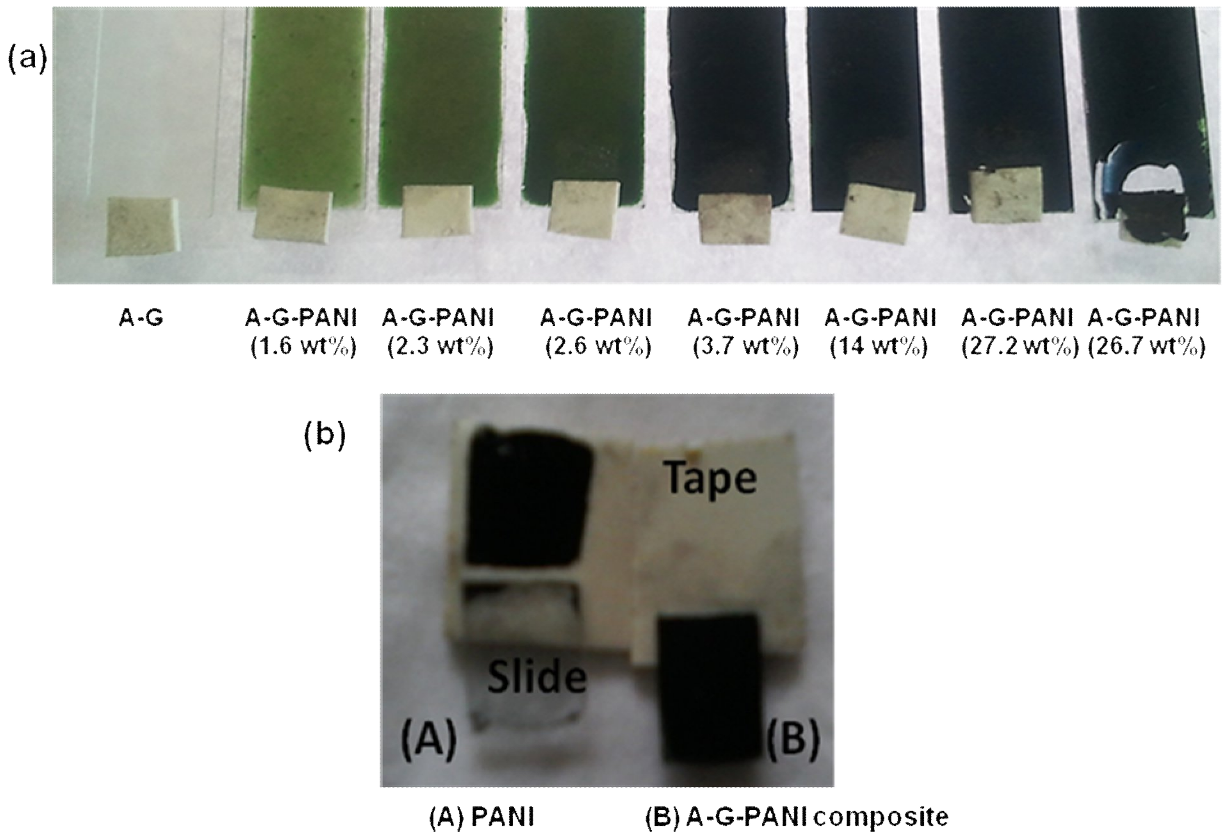

Fig S3. Photographs showing an adhesion tape test using scotch tape pressed on the surface of (a)A-G-PANI composite films with different PANI content (b) PANI and A-G-PANI composite film, deposited on a glass slide

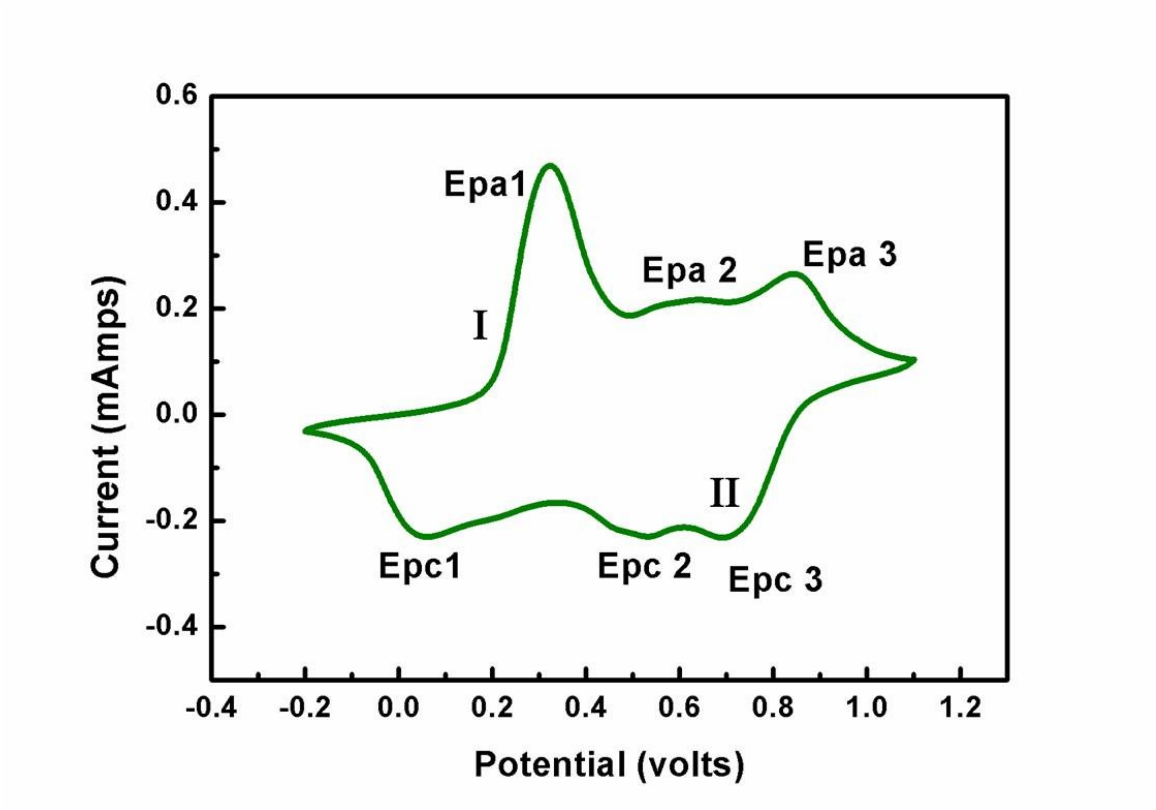

Fig. S4. Cyclic voltammogram of polyaniline in 1M HCl at the scan rate of 20 mV/Sec.

Table S1. Comparison of the standard cathodic peak potentials (scan I) and anodic peak potentials (scan II) of PANI powder and A-G-PANI film.

	Epc1	**Epc2**	**Epc3**	**Epa1**	**Epa2**	**Epa3**
PANI	0.32 V	0.62 V	0.85 V	0.04V	0.5 V	0.7 V
A-G-PANI Composite	0.45 V	-	0.68 V	0.04 V	-	0.35 V

Table S2. The values of each component in the Randle equivalent circuit for each electrode/material/ electrolyte system.

Parameters	ITO	ITO/A-G	ITO/A-G-PANI (2.3wt% PANI)	ITO/A-G-PANI (14 wt% PANI)
Rs	22.29 Ohm (dev. = 0.206 7)	25.93 Ohm (dev. = 0.245 1)	28.92 Ohm (dev. = 8.797e-3)	-15 548 Ohm (dev. = 0.280 9)
Cdl	0.242 5e-3 F (dev. = 7.015e-6)	0.223 7e-3 F (dev. =8.635e-6)	2.15e-9 F (dev. =16.54e-12)	3.23e-12 F (dev.= 2.605e-18)
Rct	56.86 Ohm (dev. = 0.456 2)	49.76Ohm (dev.=0.197 9)	230.2 Ohm (dev. = 0.124)	2.169e6Ohm (dev. = 0.333 5)
Zw	36.65Ohm.s^-1/2 (dev. = 0.398 1)	37.91Ohm.s^-1/2 (dev.= 1.245)	347.3Ohm.s^-1/2 (dev. = 2.064)	1.321e6Ohm.s^1/2 (dev. = 0.444 4)