

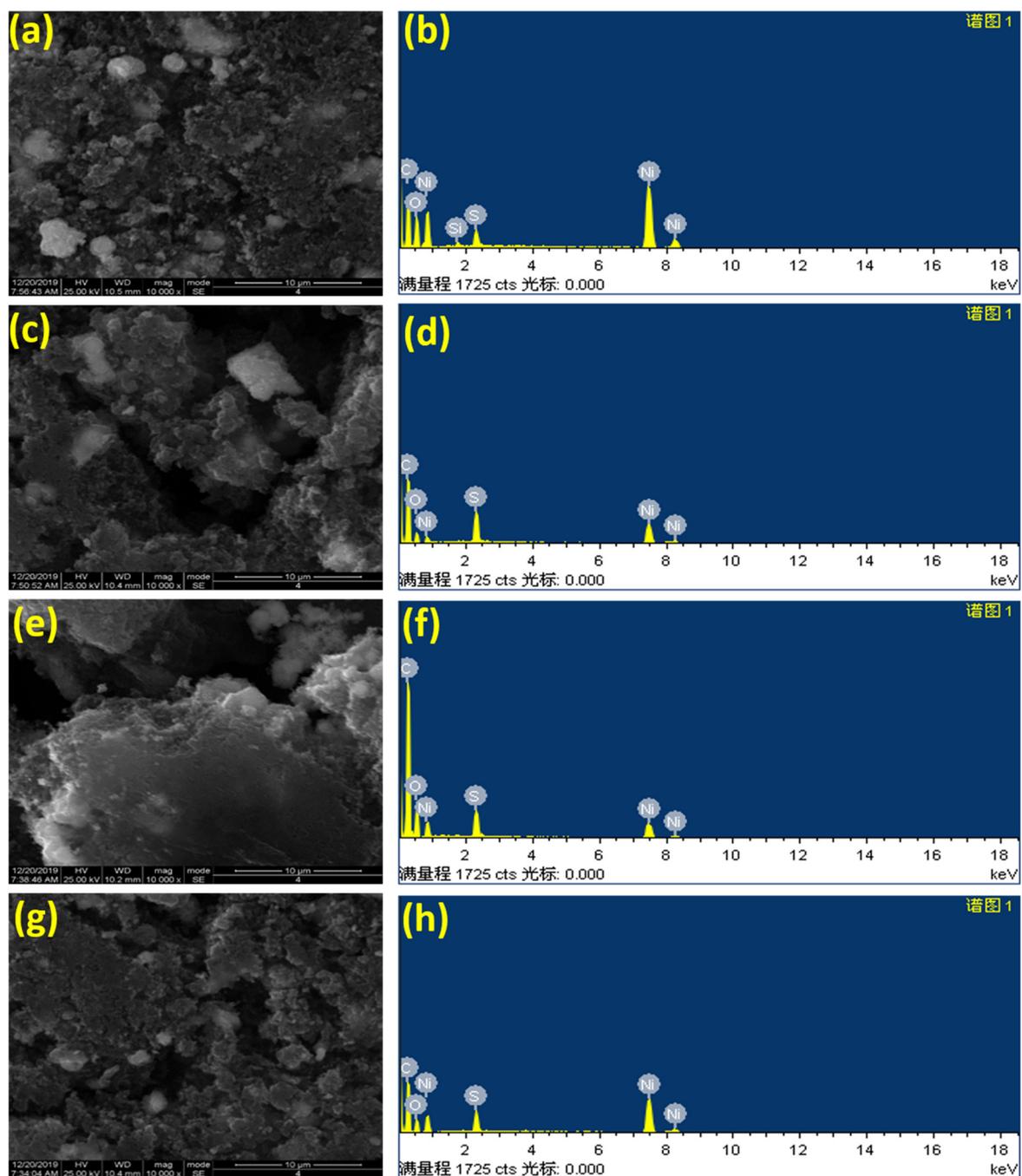
## **1. Experimental Section**

### **1.1 Materials**

Aniline was purchased from Fischer Scientific, India, and double-distilled under reduced pressure at our laboratory. Ammonium persulfate ( $(\text{NH}_4)_2\text{S}_2\text{O}_8$ ) (APS), ammonium hydroxide, nickel hydrate, sodium lauryl sulfate (sodium dodecyl sulfate (SDS)), sulfuric acid, polyvinylidene fluoride (PVDF), N-methyl-2-pyrrolidone (NMP), Ni-mesh electrode and carbon black were obtained from SD fine chemicals, India. All the mentioned chemicals were of analytical grade and were used without additional purification (except aniline). A mechanical stirrer was used for mixing in the reaction step.

### **1.2 Material characterization**

The structural features, morphology, and elemental compositions of the as-prepared samples were studied with scanning electron microscopy (SEM, Hitachi, Japan) with Oxford energy dispersive X-ray spectrometer (EDX). The phase, as well as the structure of all the samples, were studied with X-ray diffraction (XRD, Rigaku Corporation, Japan,  $\text{CuK}\alpha$  radiation, wavelength  $\lambda=0.154$  nm) in the  $2\theta$  range from  $5-80^\circ$  at a scan rate of  $2^\circ \text{ min}^{-1}$ . The crystalline phase of the materials was investigated by powder X-ray diffraction (XRD) measurements on a Bruker diffractometer using  $\text{Cu-K}\alpha$  radiation ( $\lambda = 1.5406 \text{ \AA}$ ) in the range of  $2\theta = 10^\circ - 80^\circ$ . The Fourier-transform infrared spectroscopy (FTIR) spectra of PANI and NiO-doped PANI were recorded using different wt.% of NiO using a SHIMADZU tracer-100 FTIR spectrometer with KBr as mulling agent in the range of  $4000-400 \text{ cm}^{-1}$ . The UV-visible spectra of materials dispersed in DMSO were recorded using SPECORD 200 PLUS spectrophotometer in the wavelength of range 900-200nm.



**Figure S1.** (a) Fe-SEM image of PANI-NiO-1, (b) EDX analysis of PANI-NiO-1, (c) Fe-SEM image of PANI-NiO-2, (d) EDX analysis of PANI-NiO-2, (e) Fe-SEM image of PANI-NiO-4, (f) EDX analysis of PANI-NiO-4, (g) Fe-SEM image of PANI-NiO-5, (h) EDX analysis of PANI-NiO-5.

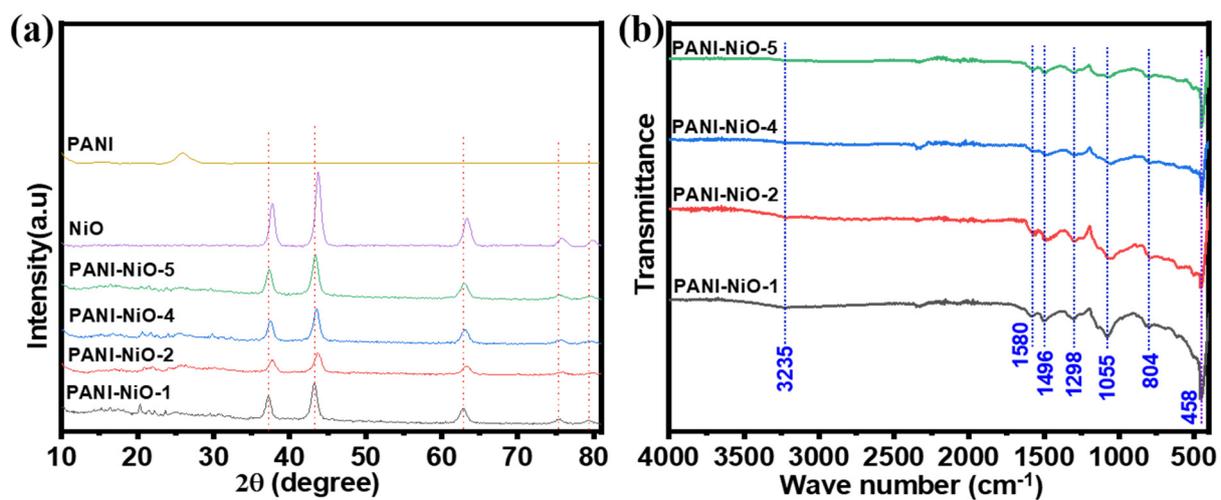
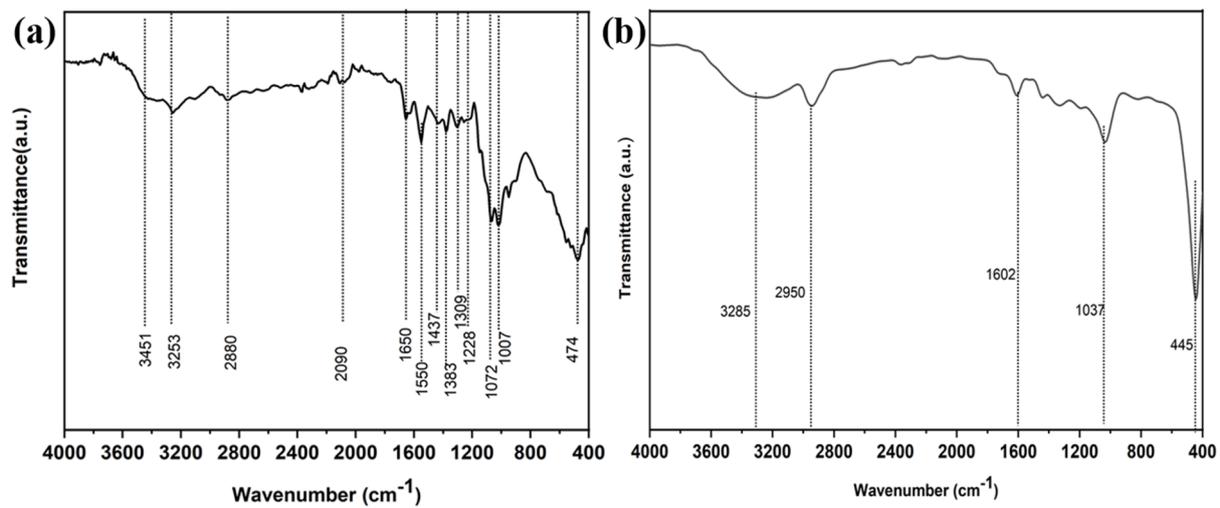
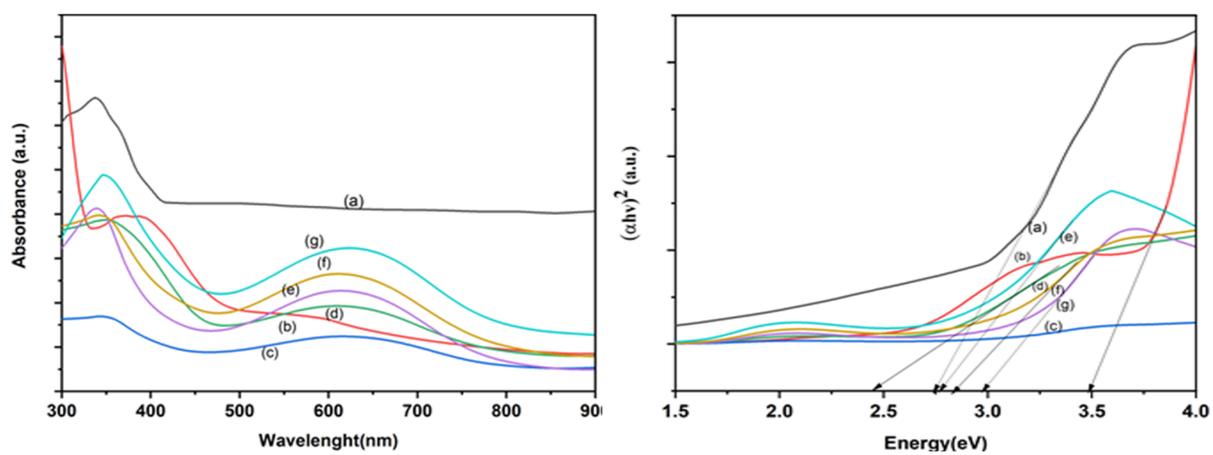


Figure S2. (a) XRD pattern of PANI, NiO, PANI-NiO-5, PANI-NiO-4, PANI-NiO-2 and PANI-NiO-1, and (b) FTIR spectra of PANI-NiO-1, PANI-NiO-2, PANI-NiO-4, and PANI-NiO-5 composites.



**Figure S3.** (a) FTIR spectra of PANI, and (b) FTIR spectra of NiO nanoparticles.



**Figure S4.** UV-Visible spectra of (a)NiO (b) PANI (c)PANI-NiO-1 (d)PANI-NiO-2 (e) PANI-NiO-3 (f) PANI-NiO-4 (g) PANI-NiO-5 and corresponding Tauc plot.