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Supporting Information

Synthesis, nanostructure evaluation and tunable anomalous 3D hopping transport of manganese ferrite encapsulated poly [3,4-(ethylenedioxy) thiophene] decorated graphene layer

Debabrata Nandi[a]*, Arjun Maity[b,c]*

[a] *Department of Chemistry, Presidency University, Kolkata 700073, India.*
[b] *Department of Civil and Chemical Engineering, University of South Africa (UNISA), South Africa.*
[c] *DST/ CSIR NCNSM, Materials Science and Manufacturing, Pretoria, South Africa.*

*Corresponding author E-Mail: nandidebabrata87@gmail.com (D.N), amaity@csir.co.za (A.M.) Phone: +2712 841 7845, Fax: +2712 841 3553

Chemicals and Analytical tools

Graphite flake (Alfa Aesar, England) used for reduced graphene oxide synthesis. The other chemicals such as hydrazine hydrate (N_2H_4. H_2O), ammonium ferric sulphate hexahydrate ($(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$), Dodecyl Benzene Sulphonic Acid (DBSA), potassium permanganate ($KMnO_4$), Manganous chloride hexahydrate ($MnCl_2 \cdot 6H_2O$), ferric chloride hexa hydrate ($FeCl_3 \cdot 6H_2O$), 3,4-ethylenedioxythiophene (EDOT) used were purchased from Sigma-Aldrich, USA. EDOT was used after distillation. Analytical tools utilized are mentioned in supporting information (S) section.

The powder X-ray diffraction (XRD) patterns of samples were taken using an X-ray diffractometer (Philips Analytical PW-1710) equipped with Cu Kα radiation at a scanning speed 0.4° $minute^{-1}$ between the angle 10° and 70° operated at voltage 40 kV and applied potential current 30mA. Raman scattering measurements were performed in the back scattering configuration using micro-Raman Jobin Yvon T64000 system to establish the bond formation among different species. Scanning electron microscopic (SEM) (Tescan Vega, U.K.; model LSU+) images were recorded for the sample by mounting on copper grids. Transmission electron micrographs (TEM) were recorded on a H800 transmission electron micrograph operated at 200 kV. The sample for the TEM was dispersed in isopropanol by sonication, and the drop cast onto 200 meshes copper grids coated with a holey carbon film. Atomic force microscopic (AFM) images were recorded on a commercial Nanoscope-III (Digital Instruments, Santa Barbara, CA) using optical beam deflection to monitor the displacement of a micro fabricated silicon cantilever having a spring constant of 80 $N.m.^{-1}$

Figure file

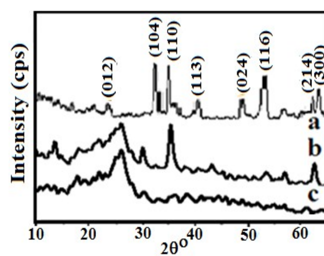

Fig. S1. XRD pattern of (a) IMO, (b) NIPG, and (c) PEDOT.

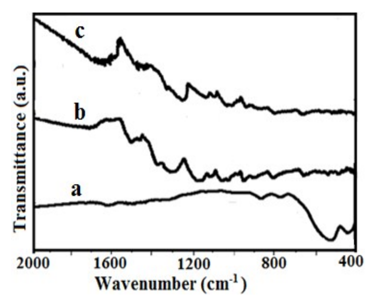

Fig. S2. FT-IR spectra of (a) IMO, (b) PEDOT, and (c) NIPG.

Table file

Table S1

Measured electrical conductivity (σ/S.cm^{-1}) of PEDOT based material at 50 and 300K with conductivity ratio(r=$\sigma_{300\ K}$ / $\sigma_{50\ K}$).

	IMO-PEDOT			GR-PEDOT			NIPG		
	300K	50K	*r*	300K	50K	*r*	300K	50K	*r*
P1	0.48	0.01	31.0	0.96	0.02	48.0	22.85	0.28	81.6
P2	0.54	0.03	18.0	8.45	0.21	40.2	40.92	1.35	30.3
P3	0.87	0.08	10.8	31.19	0.94	33.1	65.33	4.31	15.1
P4	1.16	0.12	9.6	52.75	1.88	28.0	98.52	11.02	8.9