

Supplementary Information

Ice-templating synthesis of macroporous noble metals /3D-graphene nanocomposites: their fluorescence lifetime and catalytic study

Prasanta Kumar Sahoo^{a,b*}, Bharati Panigrahy^c, Dinbandhu Thakur^b and Dharendra Bahadur^{b*}

^aDepartment of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Powai, Mumbai-400076, India

^bCentre for Nano Science and Nano Technology, Siksha 'O' Anusandhan University, Bhubaneswar 751030, Odisha

^cSolid State and Structural Chemistry Unit, Indian Institute of Science, Bangalore, 560012, India

***Corresponding Authors:**

1. Prof. Dharendra Bahadur, FRSC
Dept. of Metallurgical Engineering and Materials Science
Indian Institute of Technology Bombay
Powai, Mumbai-400076, India
Ph: 91-22-25767632, Fax: 91-22-25723480
Email: dhirenb@iitb.ac.in

2. Prof. Prasanta Kumar Sahoo
Centre for Nano Science and Nano Technology,
Siksha 'O' Anusandhan University,
Bhubaneswar 751030, Odisha, India
Ph: 91-67-42350181, Fax: 91-67-42351880
Email: prasantakumarsahoo@soauniversity.ac.in

Table S1 Comparison of 2θ values of (111) plane of Pt, Pd and Au in NM/3D-graphene nanocomposites with Joint Committee on Powder Diffraction Standards (JCPDS) data.

Planes	2θ (Degree)
Pt (111) (Pt/3D-graphene)	39.6
Pt (111) (JCPDS 00-004-0802)	39.8
Pd (111) (Pd/3D-graphene)	39.7
Pd (111) (JCPDS 00-005-0681)	40.1
Au (111) Au/3D-graphene	38.1
Au (111) (JCPDS 00-004-0784)	38.2

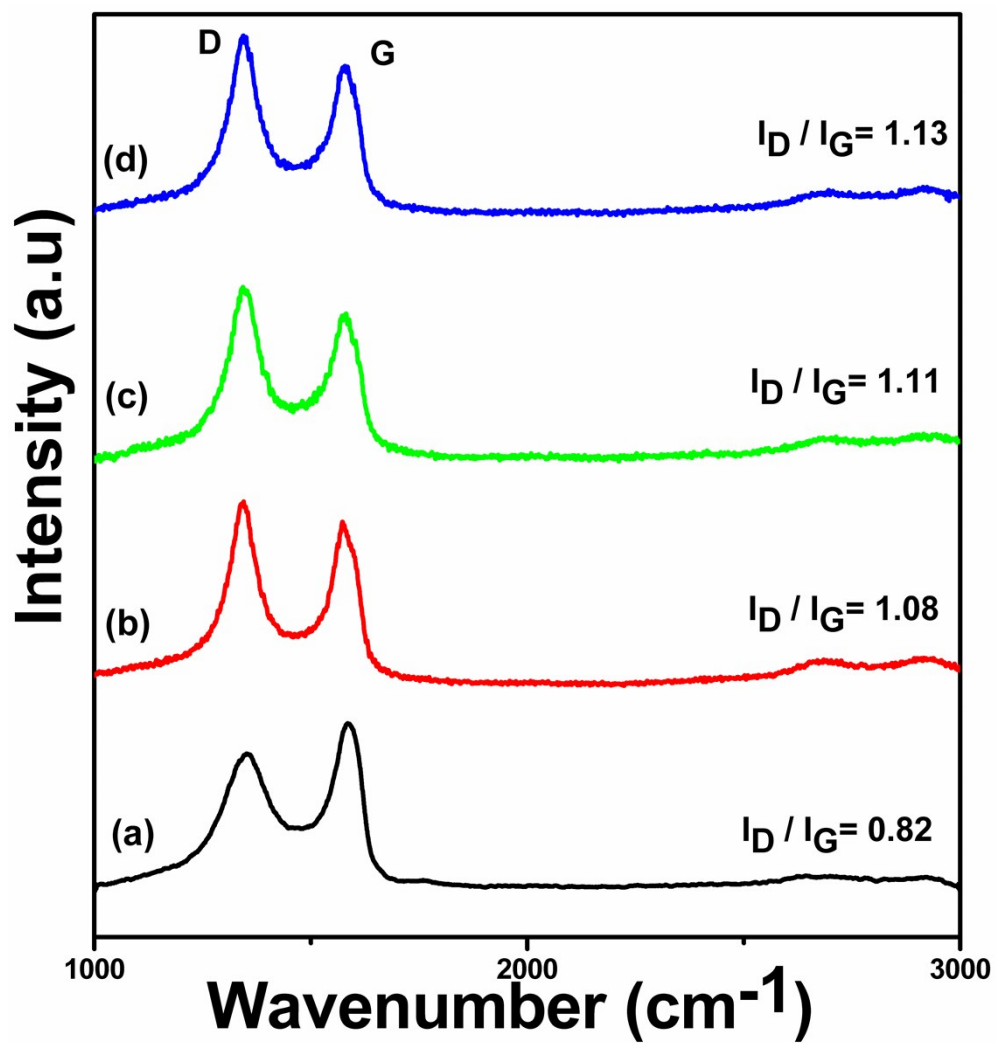


Fig.S1 Raman spectra of (a) GO, (b) Au/3D-graphene, (c) Pd/3D-graphene, and (d) Pt/3D-graphene nanocomposites.

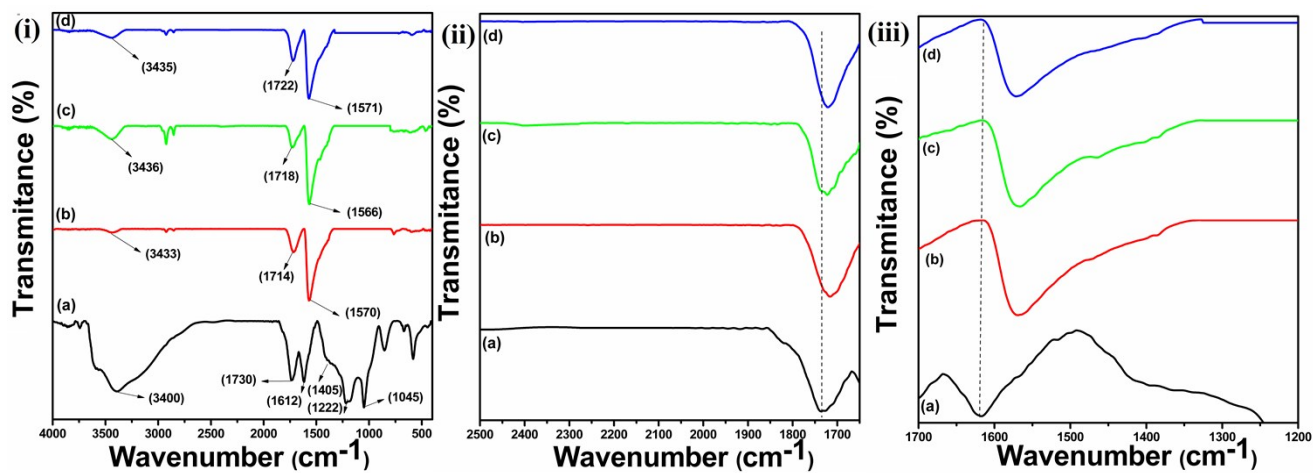


Fig.S2 (i) FTIR spectra of (a) GO, (b) Au/3D-graphene, (c) Pd/3D-graphene, and (d) Pt/3D-graphene nanocomposites; (ii) The C=O stretching vibration and (iii) O-H deformation vibration of (a) GO, (b) Au/3D-graphene, (c) Pd/3D-graphene, and (d) Pt/3D-graphene nanocomposites.

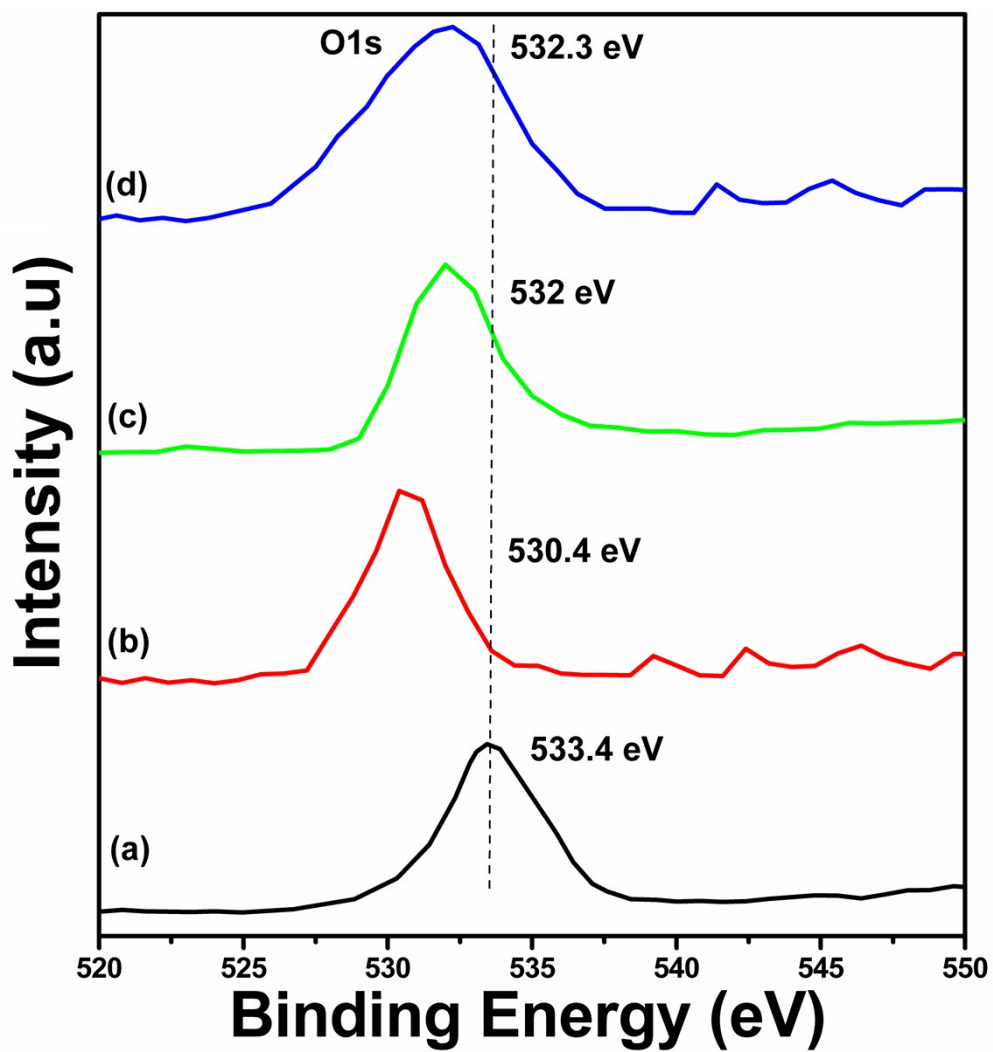


Fig.S3 O 1s XPS spectra of (a) GO, (b) Au/3D-graphene, (c) Pd/3D-graphene, and (d) Pt/3D-graphene nanocomposites.

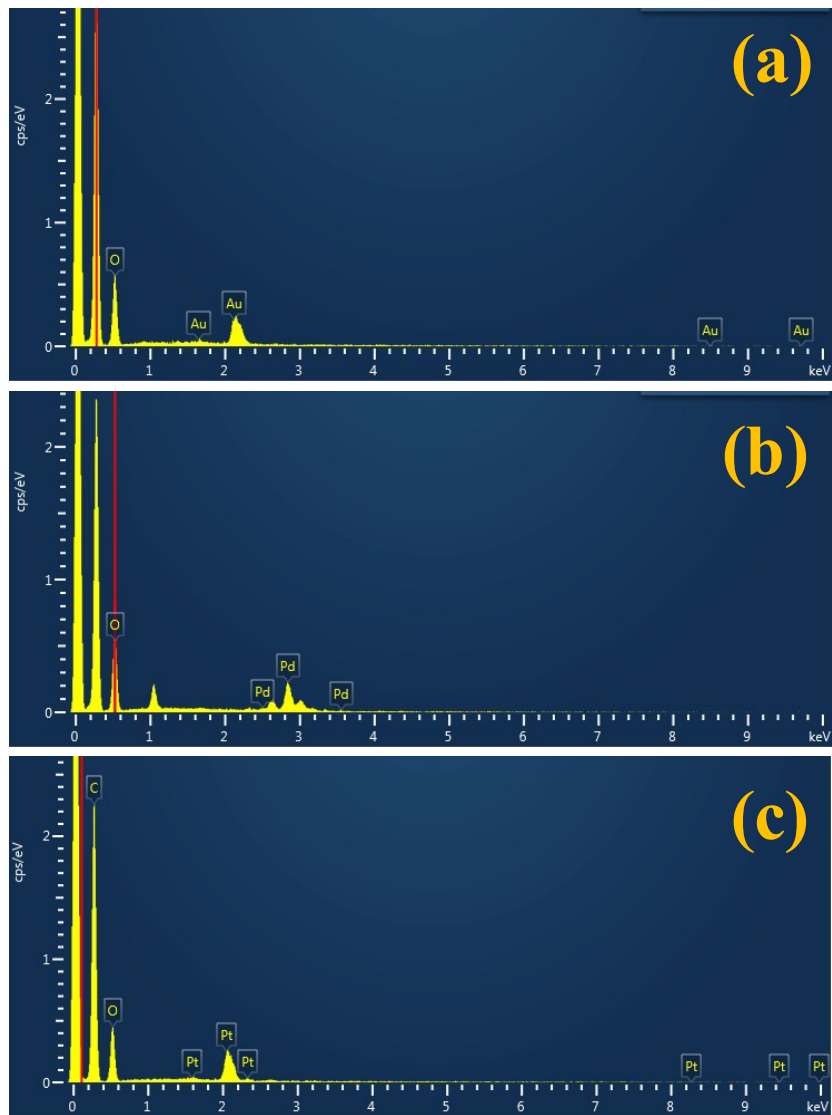


Fig.S4 Energy dispersive X-ray spectroscopy (EDS) spectra of (a) Au/3D-graphene (b) Pd/3D-graphene and Pt/3D-graphene nanocomposites.

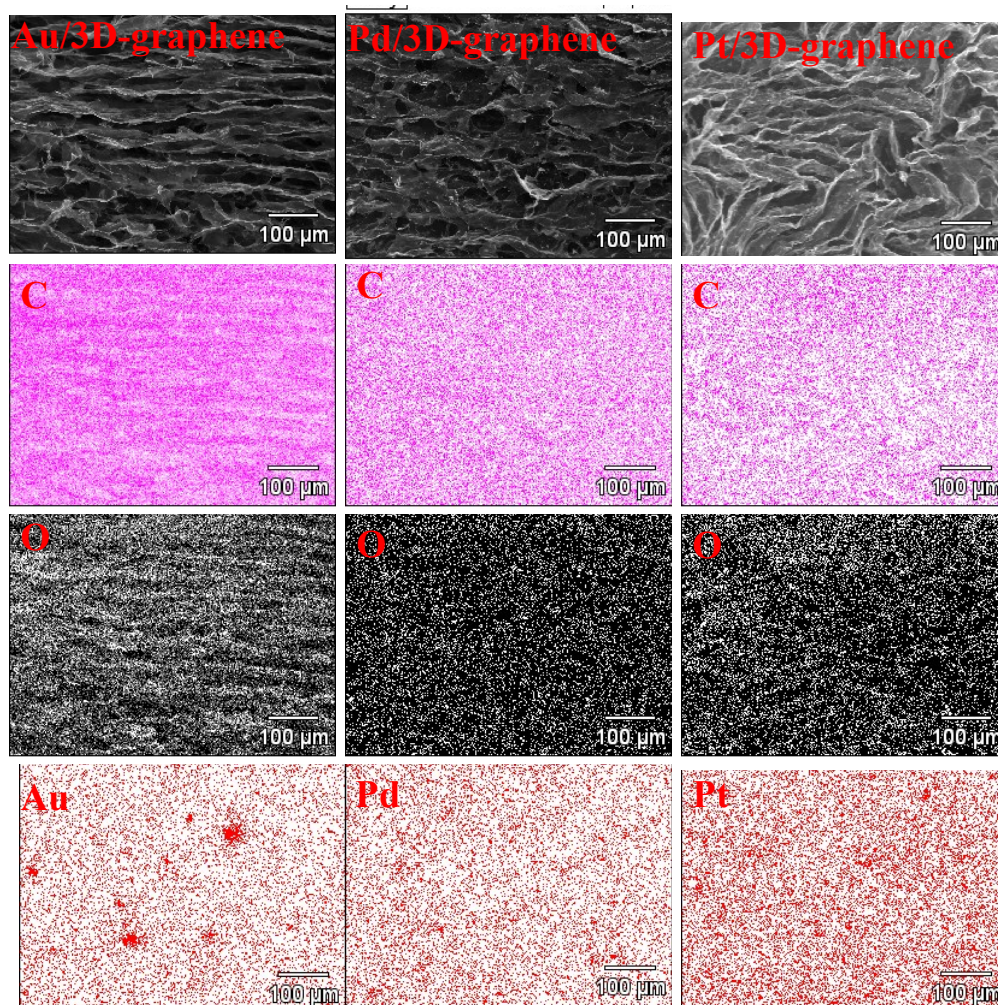


Fig.S5 EDS elemental mapping images of Au/3D-graphene, Pd/3D-graphene and Pt/3D-graphene nanocomposites.

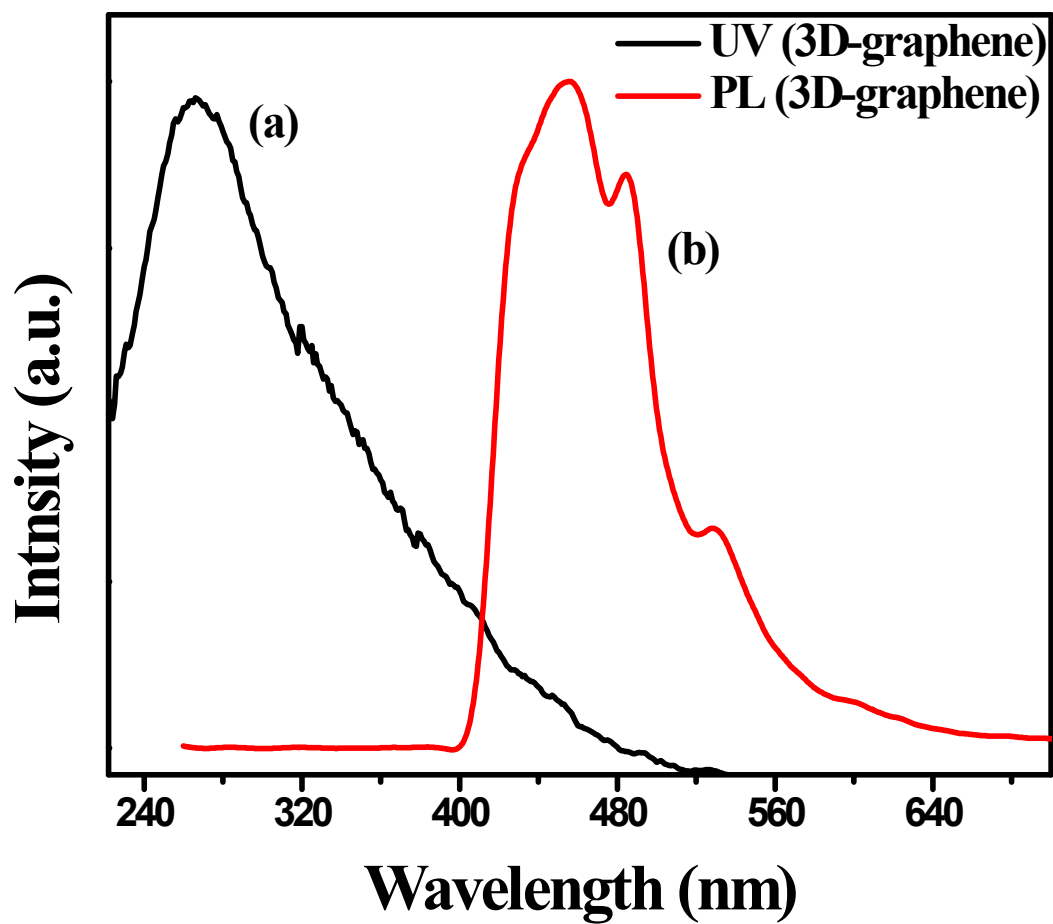


Fig.S6 (a) UV-vis absorption and (b) photoluminescence spectra of GO sheets.

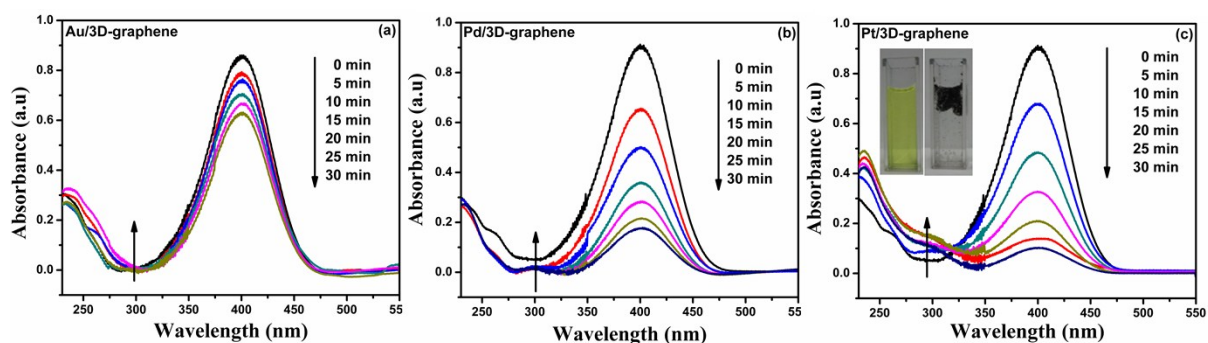


Fig.S7 UV-vis absorption spectra of 4-NP reduction by NaBH_4 in the presence of (a) Au/3D-graphene (b) Pd/3D-graphene, and (c) Pt/3D-graphene nanocomposites.

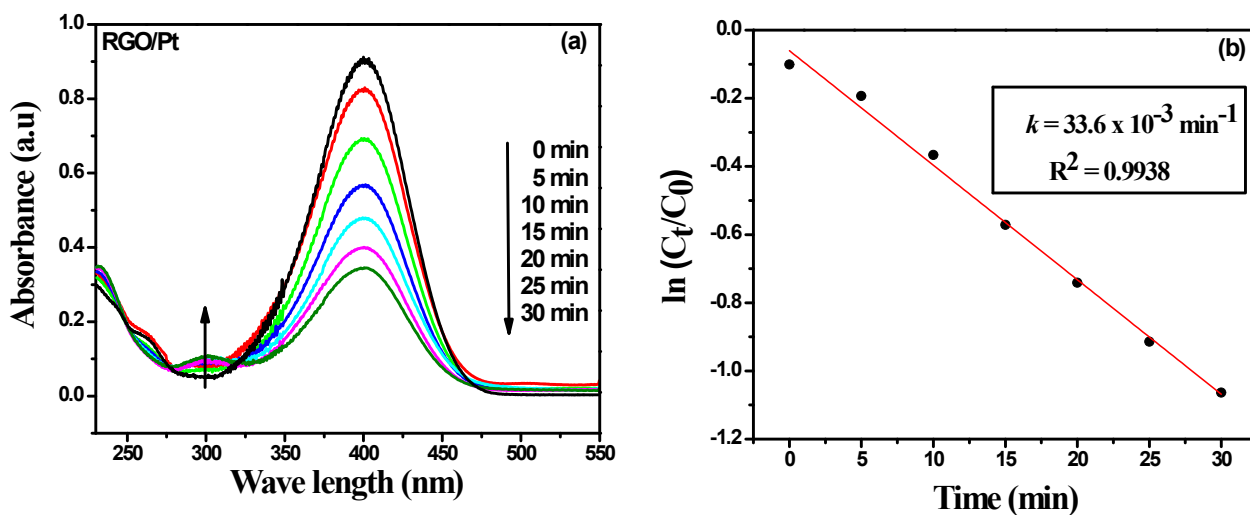


Fig.S8 (a) UV-vis absorption spectra of the reduction of 4-NP by NaBH_4 in the presence of RGO/Pt nanocomposite. (b) Plot of $\ln C_t/C_0$ versus time for the kinetic study of the reduction reaction of 4-NP in the presence of RGO/Pt nanocomposite.

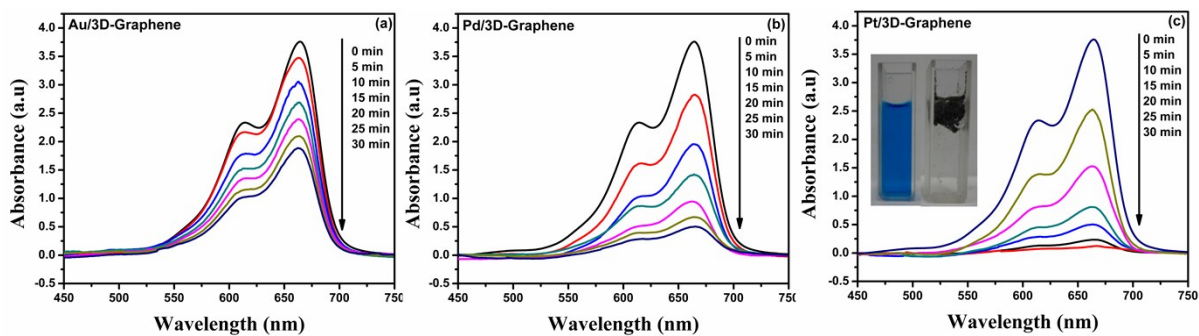


Fig.S9 UV-vis absorption spectra of MB reduction by NaBH_4 in the presence of (a) Au/3D-graphene (b) Pd/3D-graphene, and (c) Pt/3D-graphene nanocomposites.

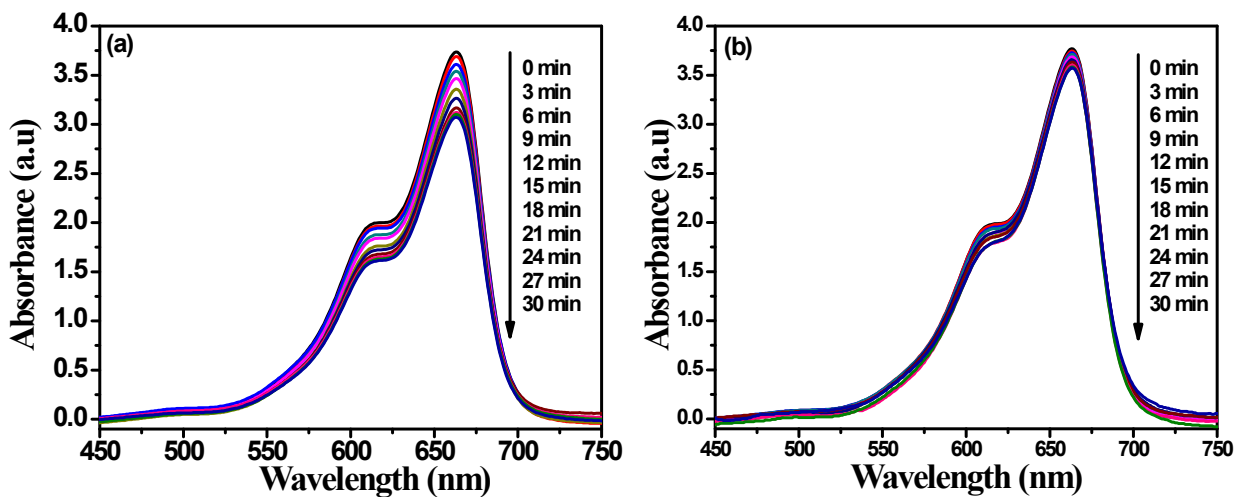


Fig. S10 UV-vis absorption spectrum of MB in presence of (a) Pt/3D-graphene and (b) RGO/Pt nanocomposites as catalysts without NaBH_4 .

Table S2 Comparison of the catalytic performances of the Pt/3D-graphene nanocomposite for the reduction of 4-NP with other reported catalysts.

	Catalyst^a	Rate constant ($\times 10^{-3} \cdot \text{min}^{-1}$)	Ref.
4-NP	Dendritic Pt	45	1
	Pt nanoflowers	42	2
	Pt/ γ -alumina	32	3
	SiO ₂ /Pt	44	4
	RGO/Pt	13.7	5
	Pt-NCs/RGO	54.5	6
	RGO/Pt-Ni	35.5	5
	Pt–Au pNDs/RGOs	3.8	7
	Pt/3D-graphene	75.3	This work

^aRGO: Reduced graphene oxide; NCs: nanocubes; pNDs: Porous nanodendrites.

References:

- 1 J. Wang, X. B. Zhang, Z. L. Wang , L. M. Wang, W. Xing and X. Liu, *Nanoscale*, 2012, **4**, 1549-1552.
- 2 S. Mourdikoudis, T. Altantzis, L. M. Lix-Marzan, S. Bals, I. Pastoriza-Santos and J. Perez-Juste, *Cryst. Eng.Comm.*, 2016, **18**, 3422-3427.
- 3 A. Dandapat, D. Jana and G. De, *ACS Appl. Mater. Interfaces*, 2009, **1**, 833-840.
- 4 H. Guan, C. Chao, Y. Lu, H. Shang, Y. Zhao, S. Yuan and B. Zhang, *J. Chem. Sci.*, 2016, **128**, 1355-1365.
- 5 P. K. Sahoo, B. Panigrahy and D. Bahadur, *RSC Adv.*, 2014, **4**, 48563-48571.
- 6 F. Li, X. Gao, Q. Xue, S. Li, Y. Chen and J. M. Lee, *Nanotechnology*, 2015, **26**, 065603.
- 7 J.J. Lv, A.J. Wang, X. Ma, R.Y. Xiang, J.R. Chen and J.J. Feng, *J.Mater.Chem. A*, 2015, **3**, 290-296.