Supporting Information:

A Facile Approach for *In Situ* Synthesis of Graphene-Branched Pt Hybrid nanostructures with Excellent Electrochemical Performance

Subash Chandra Sahu,[a,b] Aneeya K. Samantara,[a,b] Biswarup Satpati, [c] Sarama Bhattacharjee[a,b] and Bikash Kumar Jena*[a,b]

[a] Colloids & Materials Chemistry, CSIR-Institute of Minerals and Materials Technology, Bhubaneswar-751013, India,

[b] Academy of Scientific & Innovative Research, New Delhi-751013, India.

[b] Saha Institute of Nuclear Physics, 1/AF Bidhannagar, Kolkata-700 064, India.

Figure S1: (a, b) FESEM, (c, d) TEM and (e-h) AFM measurements for as-synthesized GOs.

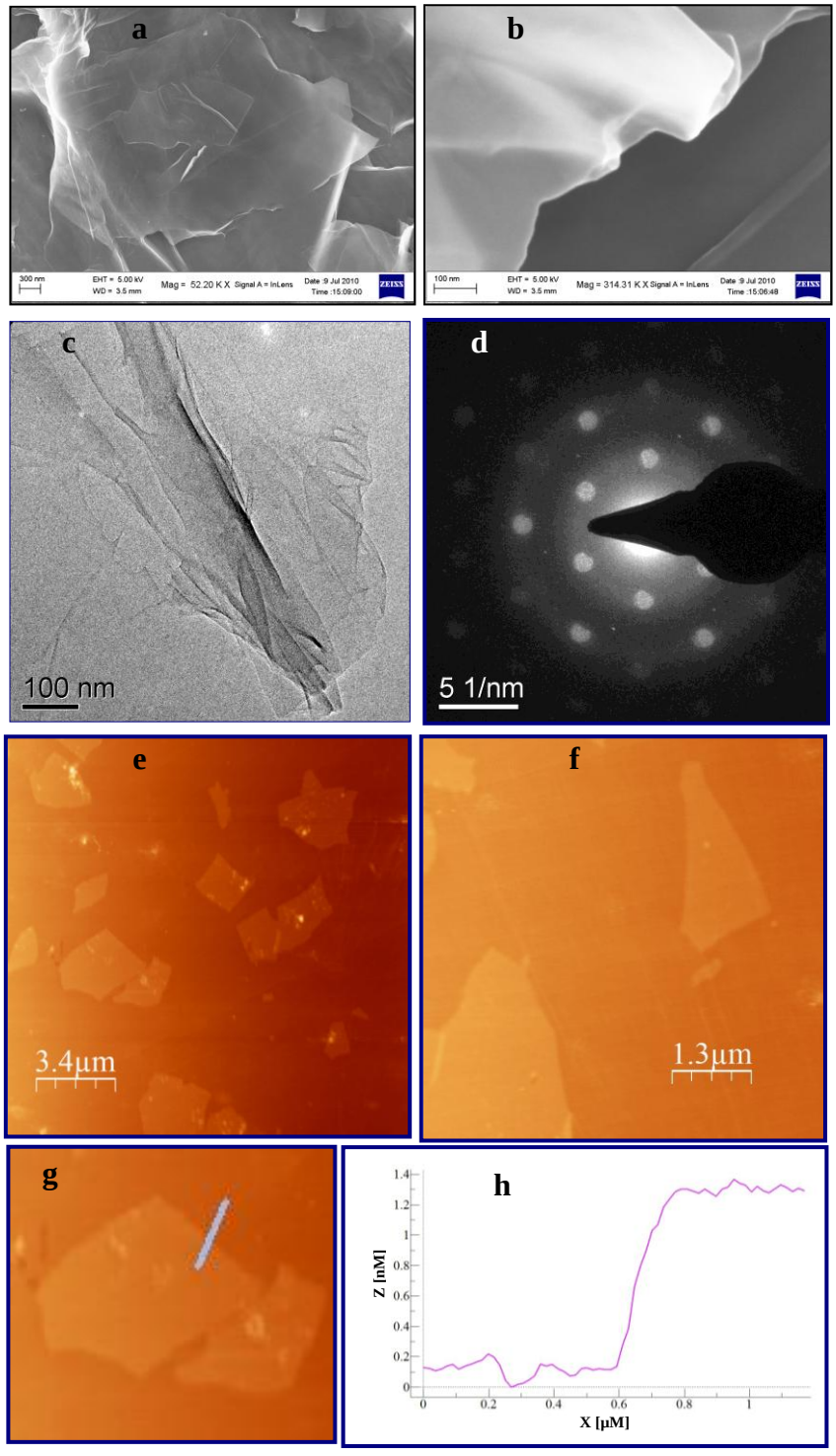


Figure S2: TEM images of as-synthesized graphene supported branched Pt nanostructures (GR-BPtNs).

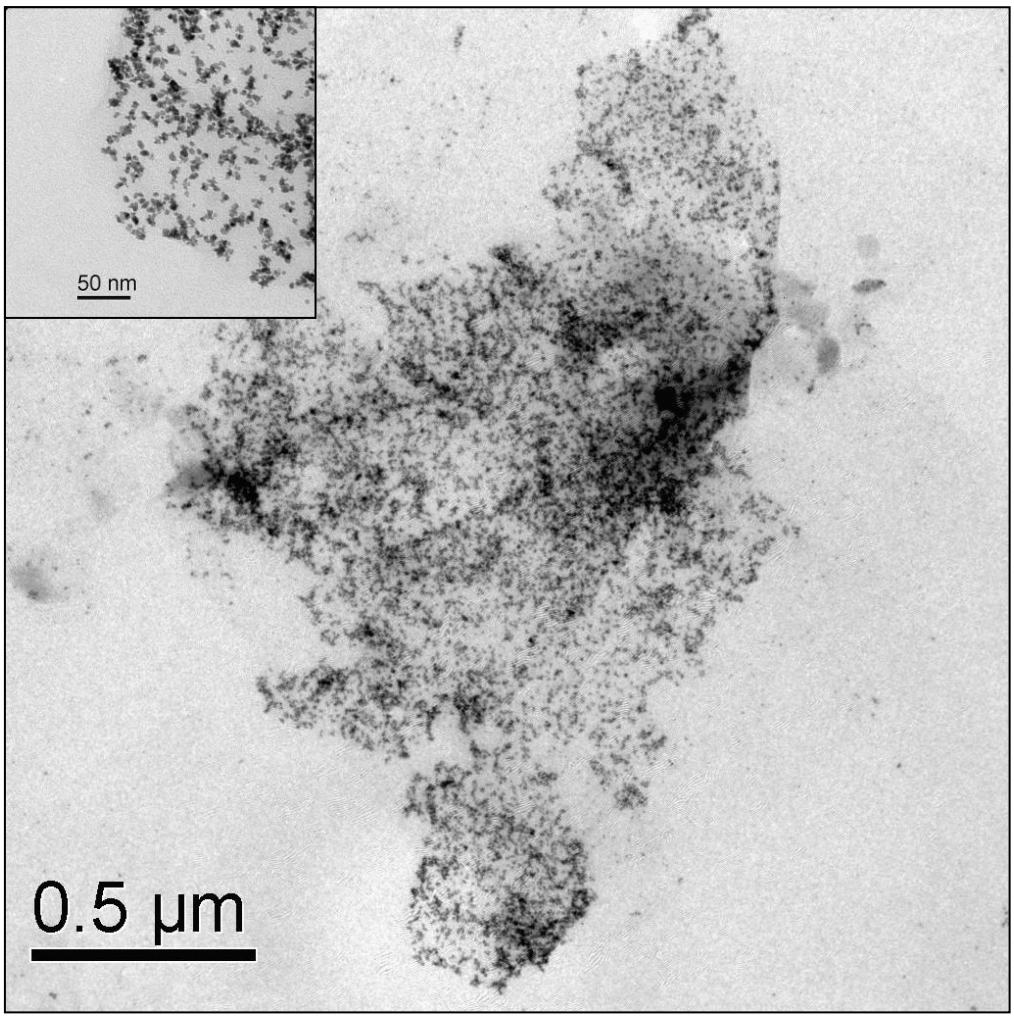


Figure S3: EDAX pattern of GR-BPtNs

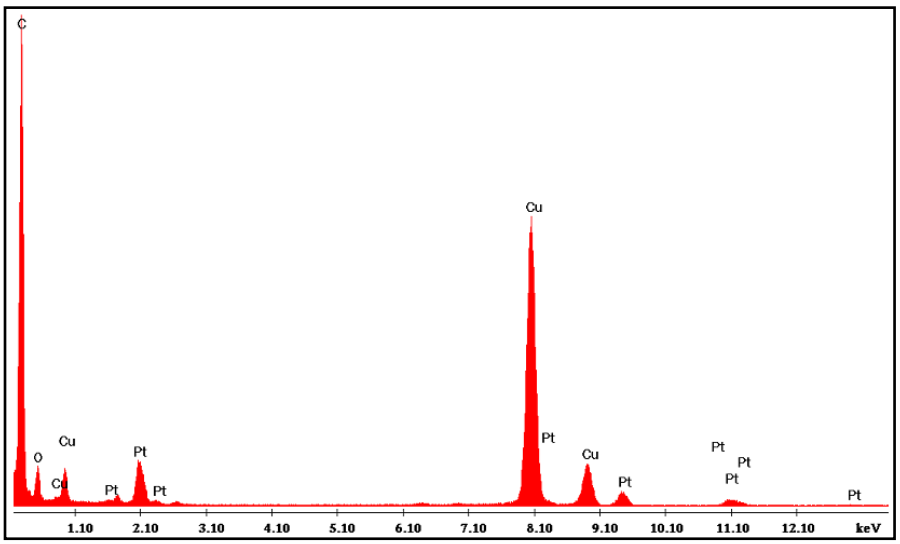


Figure S4: XPS spectra of graphene supported branched Pt nanostructures (GR-BPtNs)

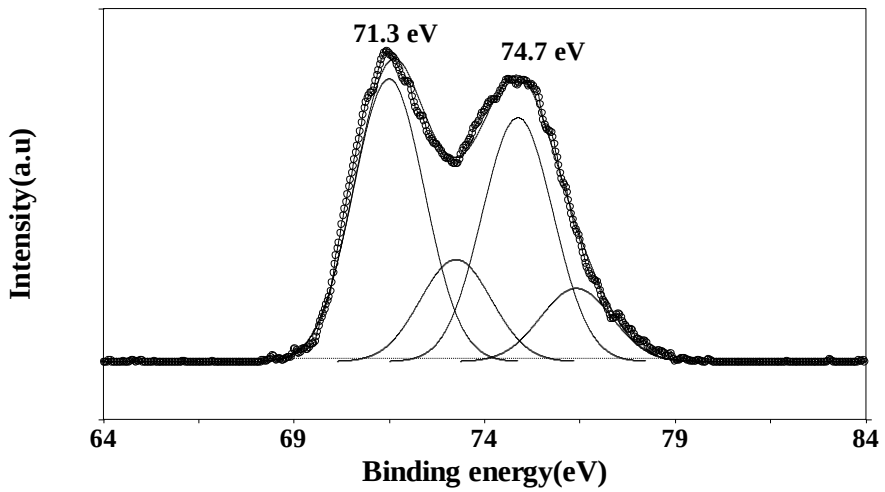


Figure S5: UV-visible spectra of as-synthesized GO (a) and GR-BPtNs (b). Inset shows their optical images.

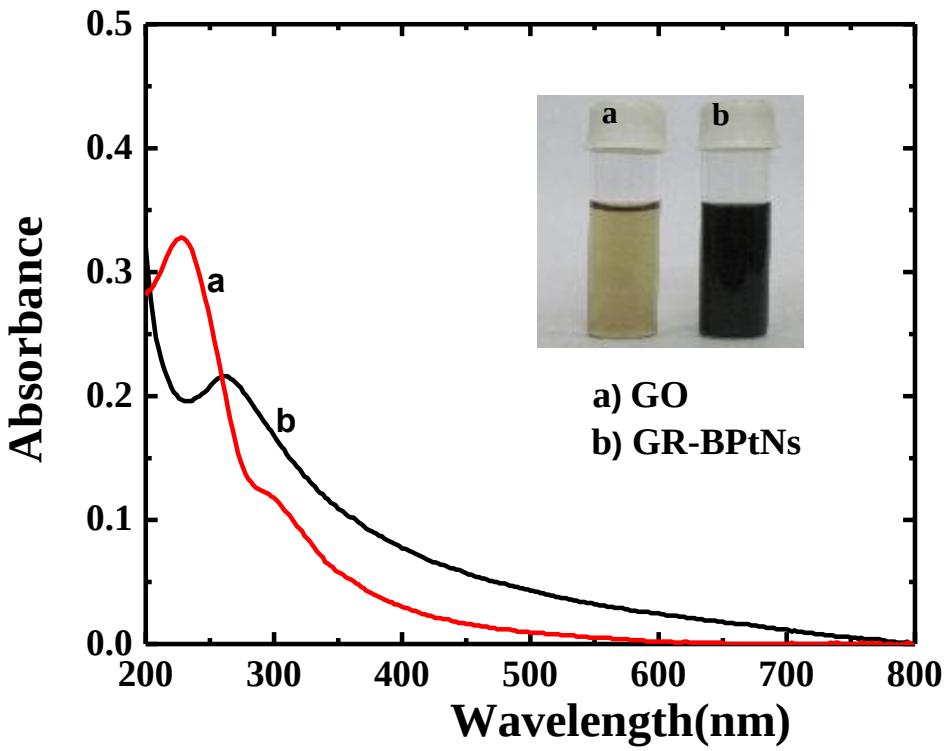
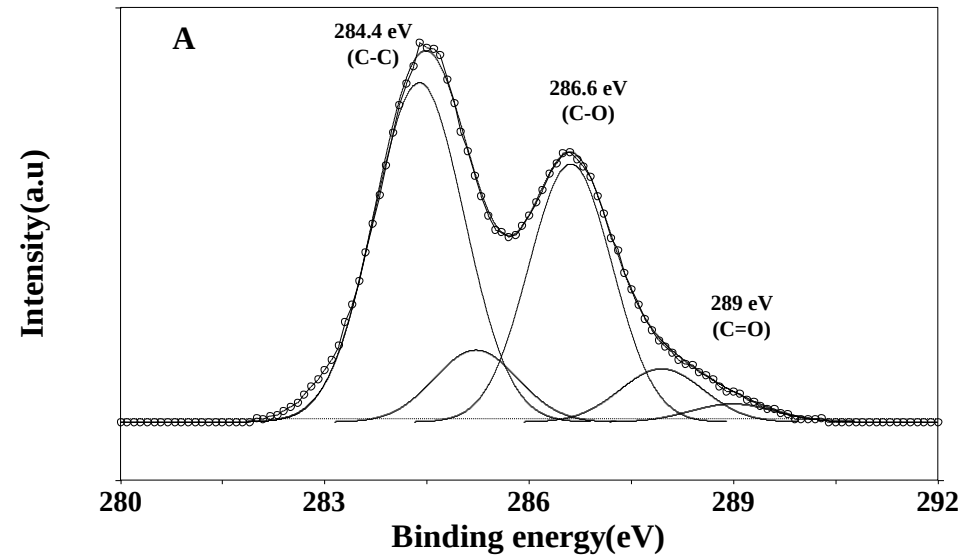


Figure S6: XPS Spectra of GO (A) and GR (B)



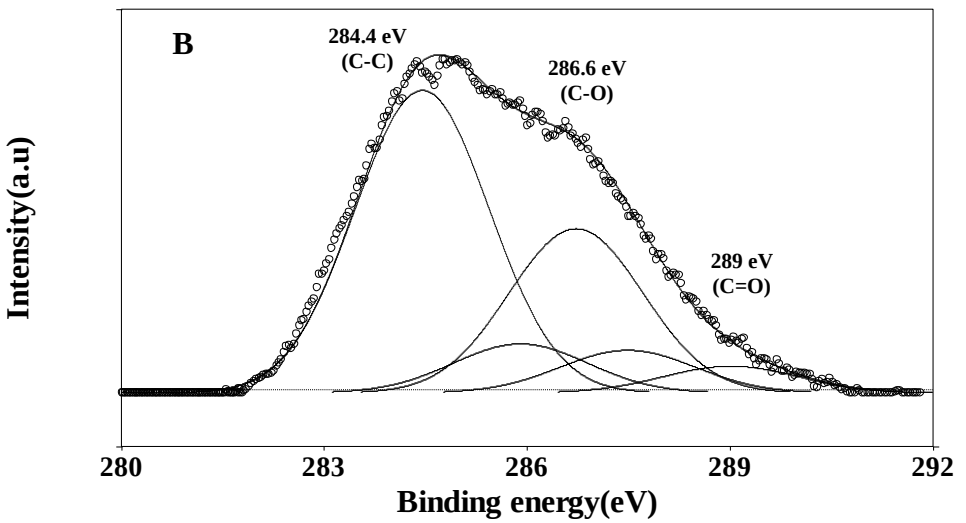


Figure S7: Characteristic Raman spectra of (a) GO and (b) GR-BPtNs.

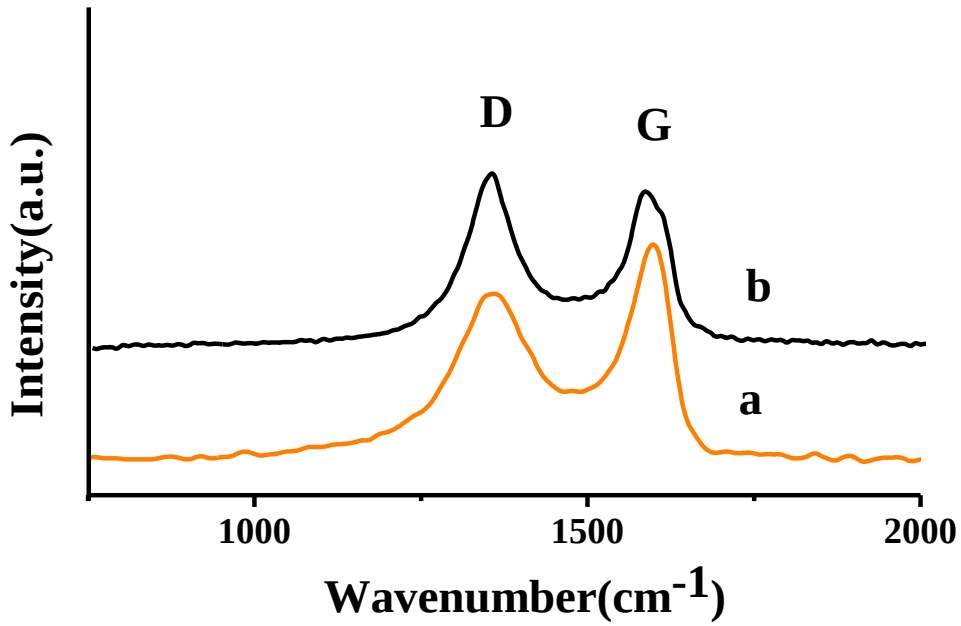


Figure S8: TEM images of Pt Ns synthesized in absence (A) and presence (B) of graphene support under same conditions.

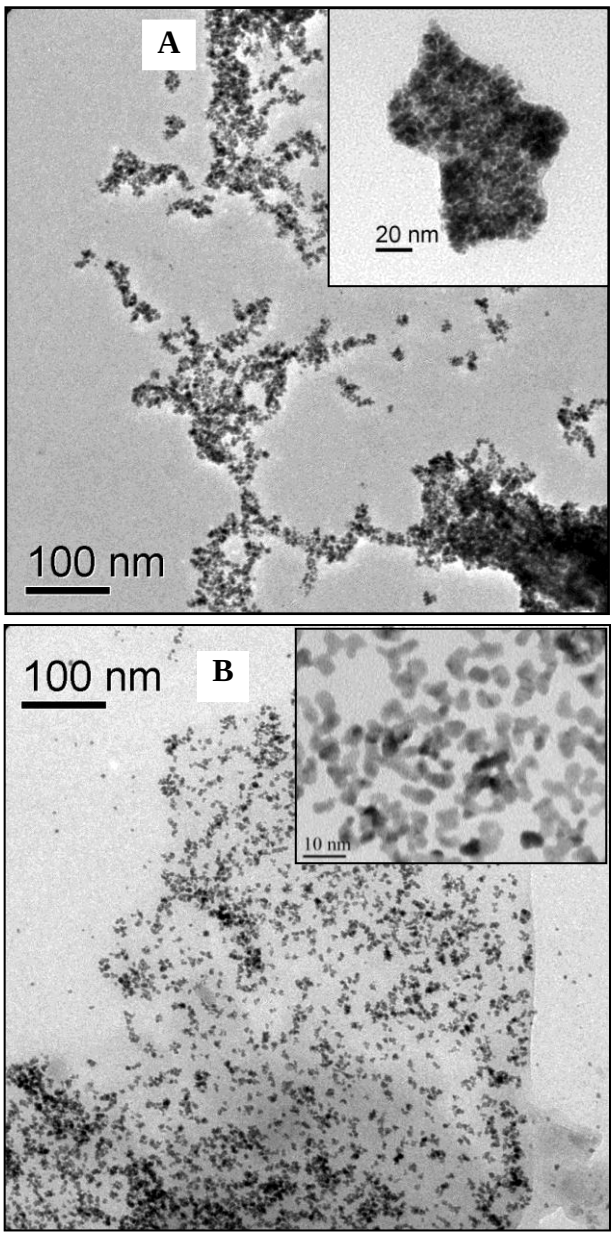


Figure S9: The proposed scheme showing the formation of Pt nanostructures in presence (A) and absence (B) of graphene support.

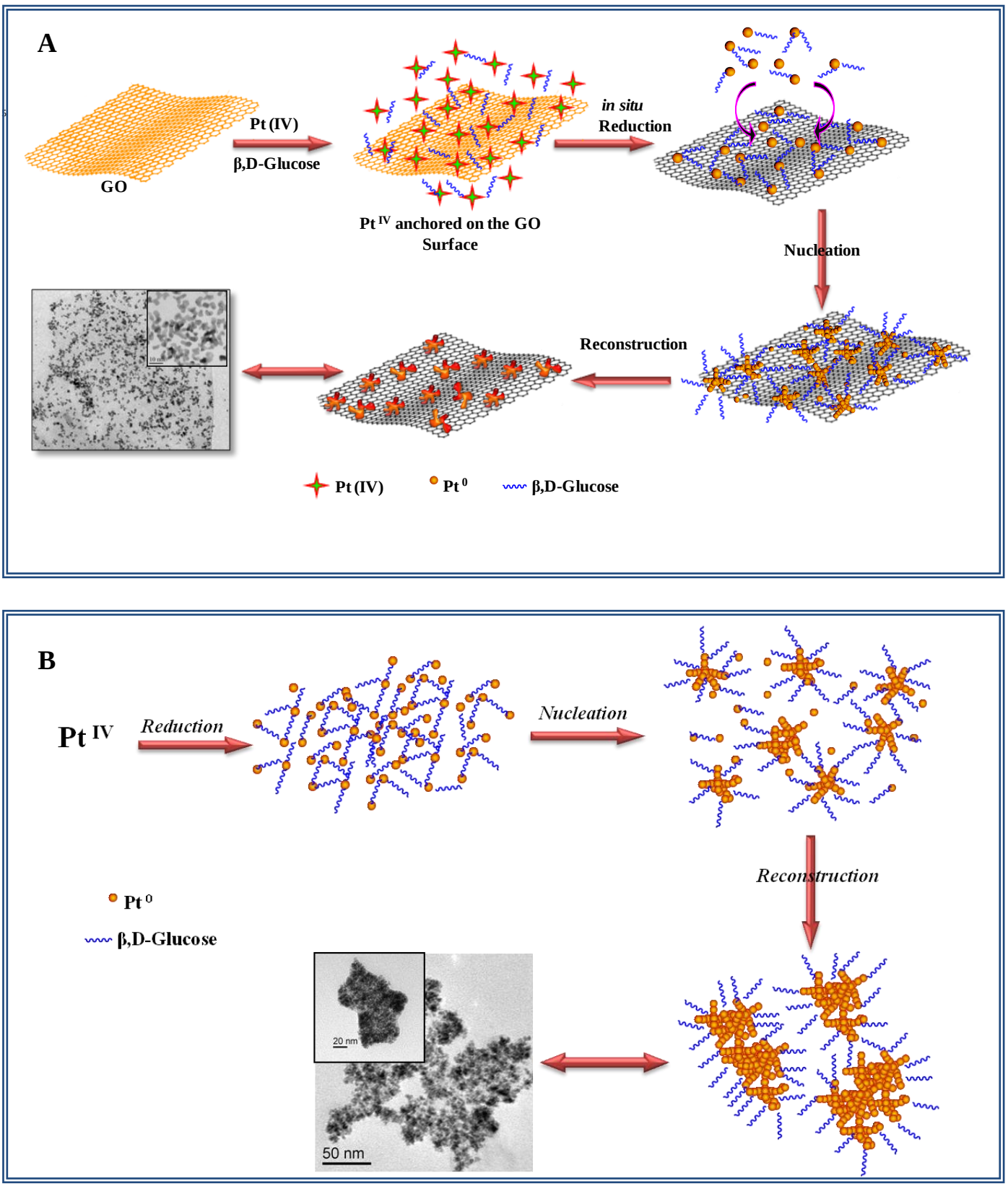


Figure S10: TEM images of graphene supported Pt nanostructures in absence of glucose under same conditions.

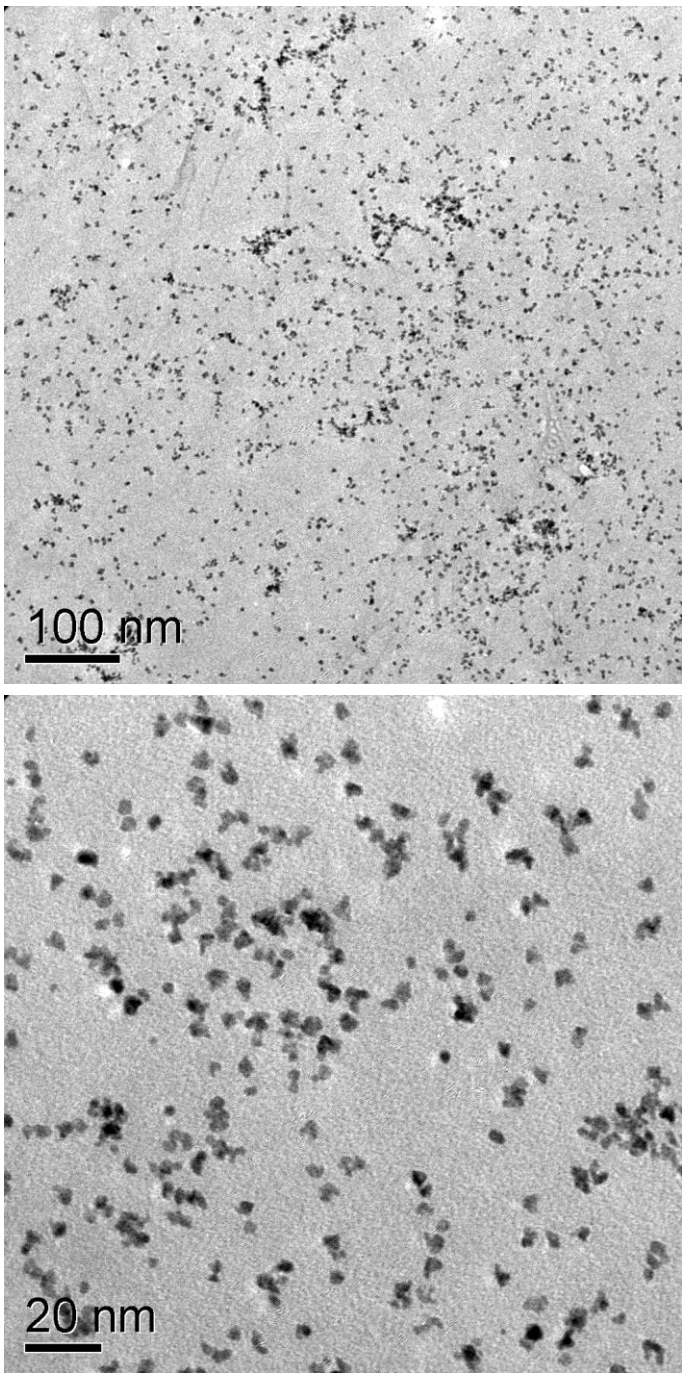
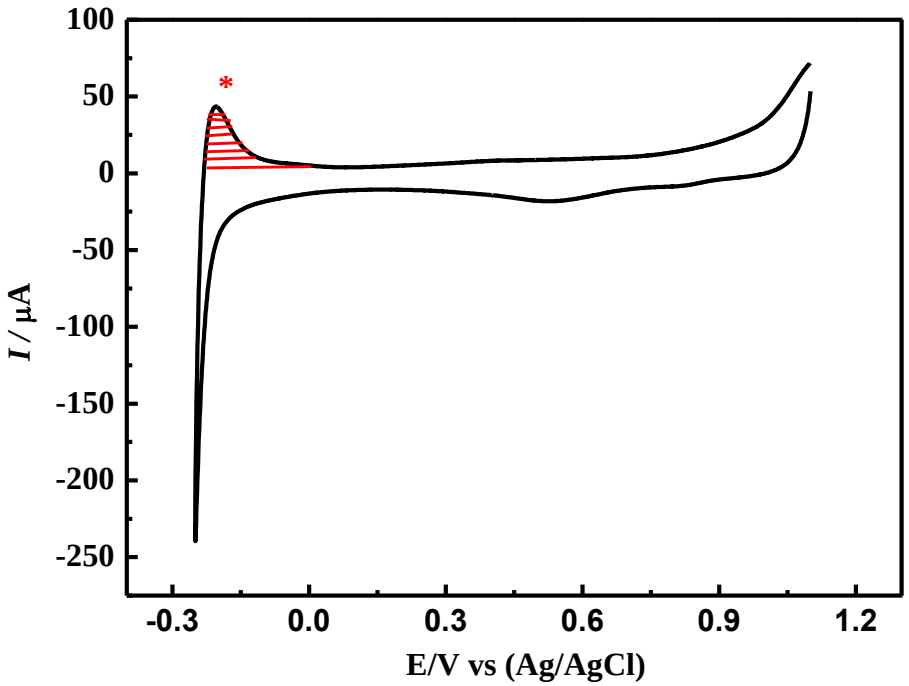


Figure S11: Cyclic Voltammetric profile of GR-BPtNs modified electrode in 0.5 M H_2SO_4. Scan rate: 10 mV/s



*** The charge involved for the hydrogen adsorption (Q_H) is estimated from the area under the potential window associated with oxidation curve. The electrochemically accessible surface area (ECSA) of GR-BPtNs was calculated to be 1.42 cm^2 with reference to the standard value of 210 $\mu C/cm^2$. [1]**

1. D.W. Blakely and G.A. Somorjai, *Surf. Sci.* 1977, **65,** 419-442.

Figure S12 (Table 1): Summarized the electrocatalytic activity of different electrodes towards oxidation of methanol (0.25M).

Electrocatalyst	Oxidation Potential (V)	Forward Current density (μA/cm^2)	I_f/I_b ratio
GR-BPtNs	0.696±0.004	178.10±53.56	2.11±0.11
Pt/C	0.719±0.008	12.47±1.84	1.49±0.17
PtNs	0.679±0.011	3.56±2.42	1.24±0.44

Figure S13: Chronoamperometric data obtained for GR-BPtNs, Pt/C and PtNs modified electrodes towards oxidation of methanol (0.25M). Potentials are held at their oxidation potential.

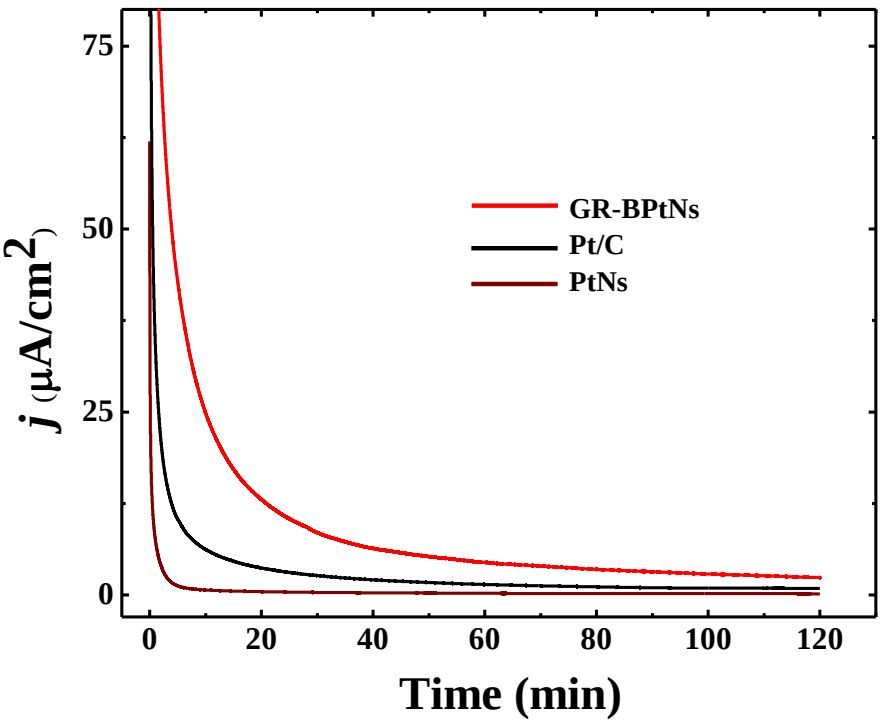
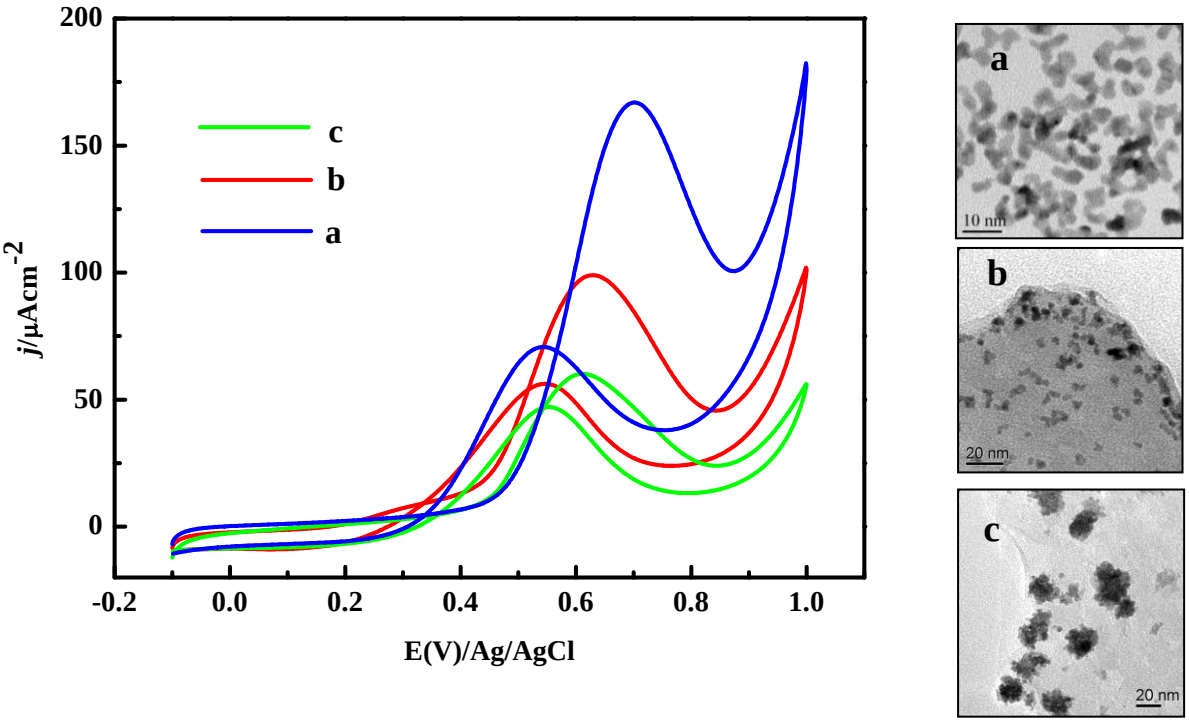


Figure S14: Cyclic Voltammograms of different graphene supported Pt nanostructures synthesized at different pH conditions towards oxidation of methanol (0.25M) in 0.5M H_2SO_4. Scan rate: 10 mV/s.



RG-Pt Nanostructures at different pH	Oxidation Potential(V)	Forward Current density ($\mu A/cm^2$)	I_f/I_b ratio
pH 7.7 (a)	0.696±0.003	178.10±53.56	2.11±0.11
pH 10 (b)	0.68±0.05	81.541±11.81	1.7±0.37
pH 10 (c)	0.610±0.005	56.828±1.19	0.943±0.106

Figure S15: Cyclic Voltammograms of graphene supported Pt nanostructures synthesized in absence (a) and presence (b) of glucose with similar dimension towards oxidation of methanol (0.25M) in 0.5M H_2SO_4. Scan rate: 10 mV/s.

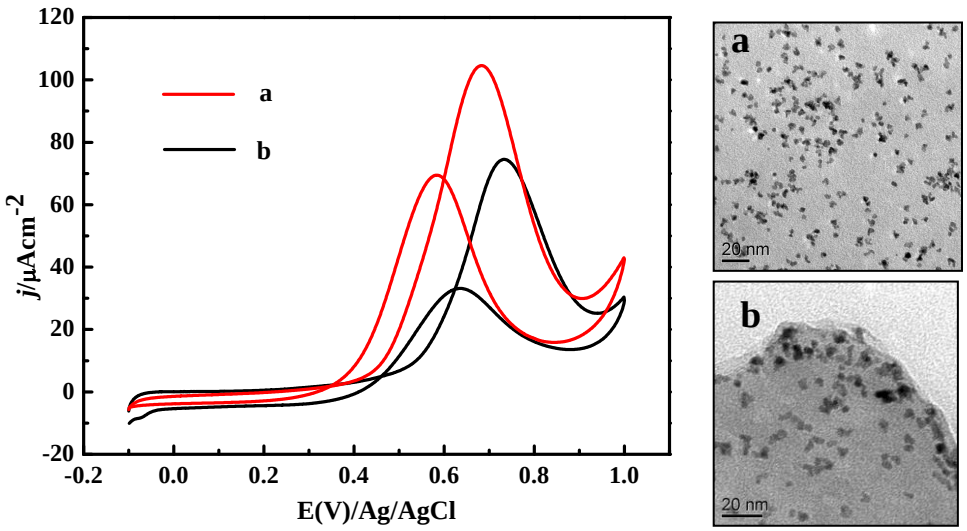


Figure S16. Cyclic Voltammograms of different loading of GR-BPtNs (different electrochemically accessible surface areas, ECSA) on GC electrode surface towards the oxidation of methanol (0.25M) in 0.5M H_2SO_4. a: 1.23, b: 1.42, c: 1.66 and d: 2.53 cm^2 Scan rate: 10 mV/s.

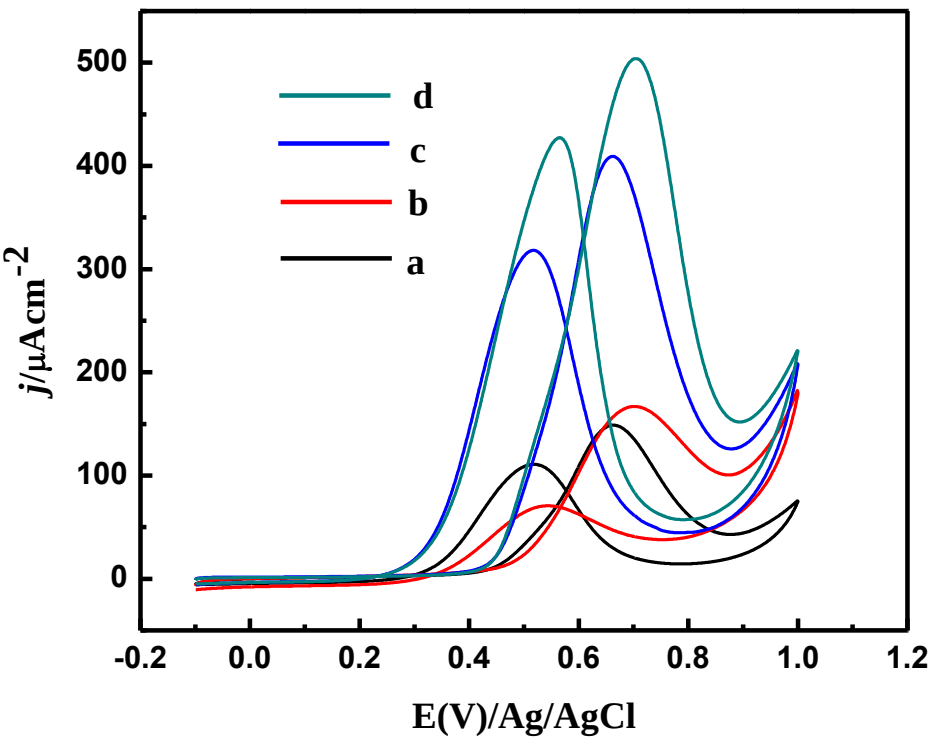


Figure S17 (Table 2): Summarized the electrocatalytic activity of different electrodes towards reduction of oxygen.

Electrocatalyst	Onset Potential(V)	Half Wave Potential, $E_{1/2}$(V)	Reduction Current density (μA/cm^2)
RG-BPtNs	0.674±0.003	0.489±0.005	421.584±15.484
Pt/C	0.596±0.004	0.377±0.026	16.773±2.193
PtNs	0.582±0.002	0.287±0.011	11.56±1.175

Figure S18: shows the typical RDE voltammograms for O_2 reduction on (a) graphene supported branched PtNs (GR-BPtNs, synthesized at pH 7.7), (b) graphene supported PtNs synthesized in absence of glucose residue (figure S10) (c) graphene supported PtNs synthesized at pH 10 (Figure 4 B), and (d) graphene supported PtNs synthesized at pH 3 (Figure 4 A) modified electrodes in 0.5M H_2SO_4 at 300 rpm. Scan rate: 5mV/s.