Electronic Supplementary Information

Sunlight induced unique morphological transformation in graphene based nanohybrids: appearance of a new tetra-nanohybrid and tuning of functional property of these nanohybrids

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Instrumentations

UV-Vis spectroscopy study: UV-Vis absorption spectra were recorded on a Hewlett-packard (model 8453) UV-Vis spectrophotometer (varian carry 50.bio). All experiments have been carried out in an optical quartz cell and monitored the spectra time to time over a range of wavelengths 350-800 nm.

Fluorescence Study: The fluorescence spectra were obtained using a Perkin-Elmer Spectrofluorimeter

X-ray Photoelectron Spectroscopic (XPS) Study: XPS analysis was carried out by using an X–ray photoelectron spectroscopic (XPS, Omicron, model: 1712–62–11) method. Measurement was done by using an Al-Kα radiation source under 15 kV voltages and 5 mA current.

Transmission Electron Microscopy (TEM) Study: Transmission Electron Microscopic (TEM) experiments were carried out to investigate the morphology of these hybrid hydrogels. TEM images and EDX analyses were recorded on a JEM 2010F electron microscope at an accelerating voltage of 200 KV.

MALDI-TOF analysis: The MALDI-TOF analysis was carried out by using Bruker Daltonics flex Analysis mass spectrometer.

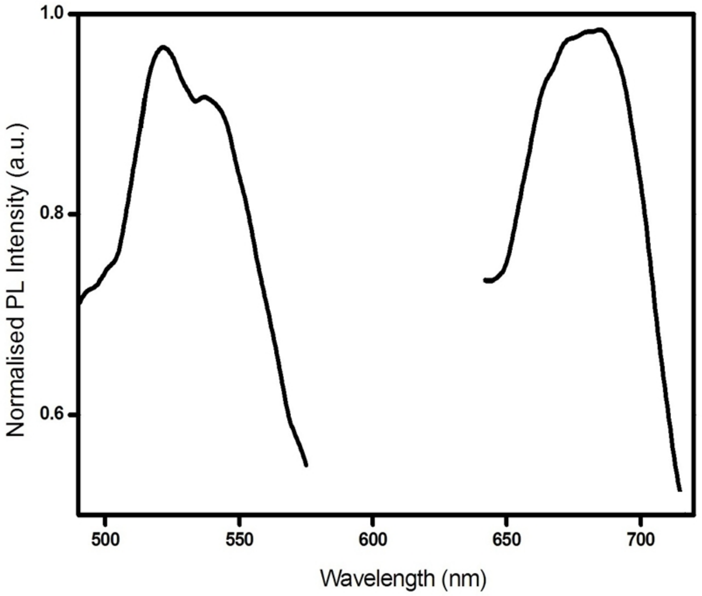

Fig. S1 Normalised (A) PL and (B) PLE spectra of the silver nanoclusters.

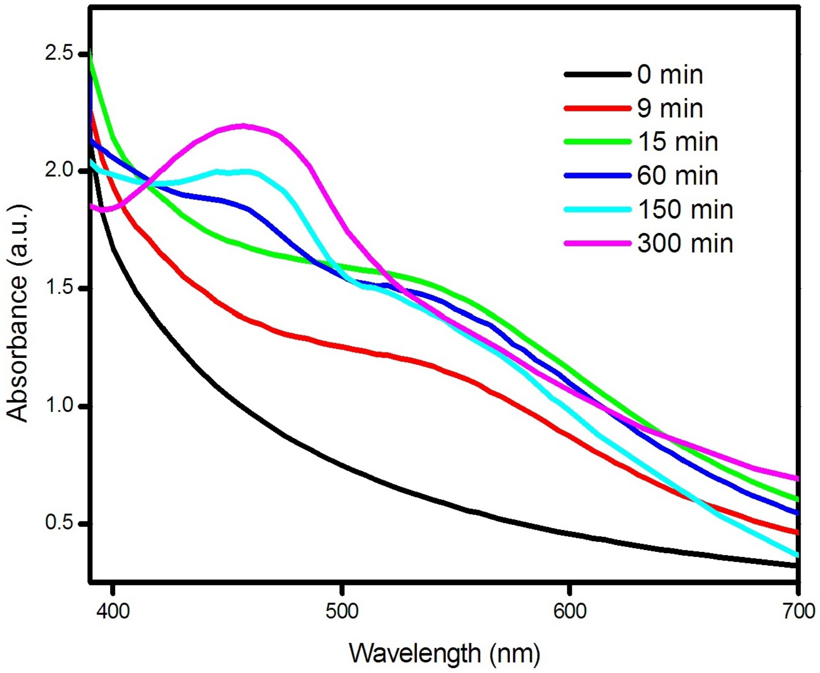

Fig. S2 Time-dependent UV-Vis spectroscopic analysis for the transformation of silver nanoclusters to silver nanoparticles.

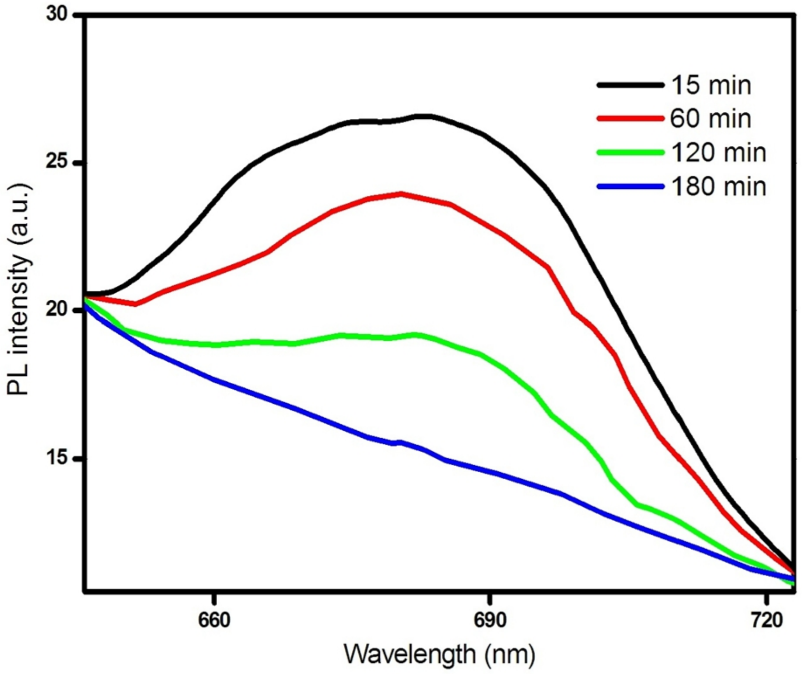

Fig. S3 Time-dependent fluorescence spectroscopic analysis showing quenching of emission spectra during nanoclusters to nanoparticle formation.

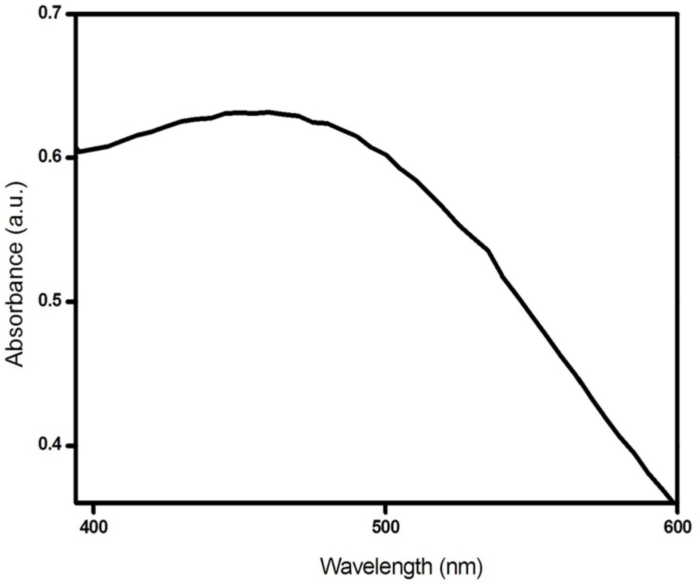

Fig. S4 UV-Vis spectra for formation of silver nanoparticles within the hydrogel by exposure of direct sunlight.

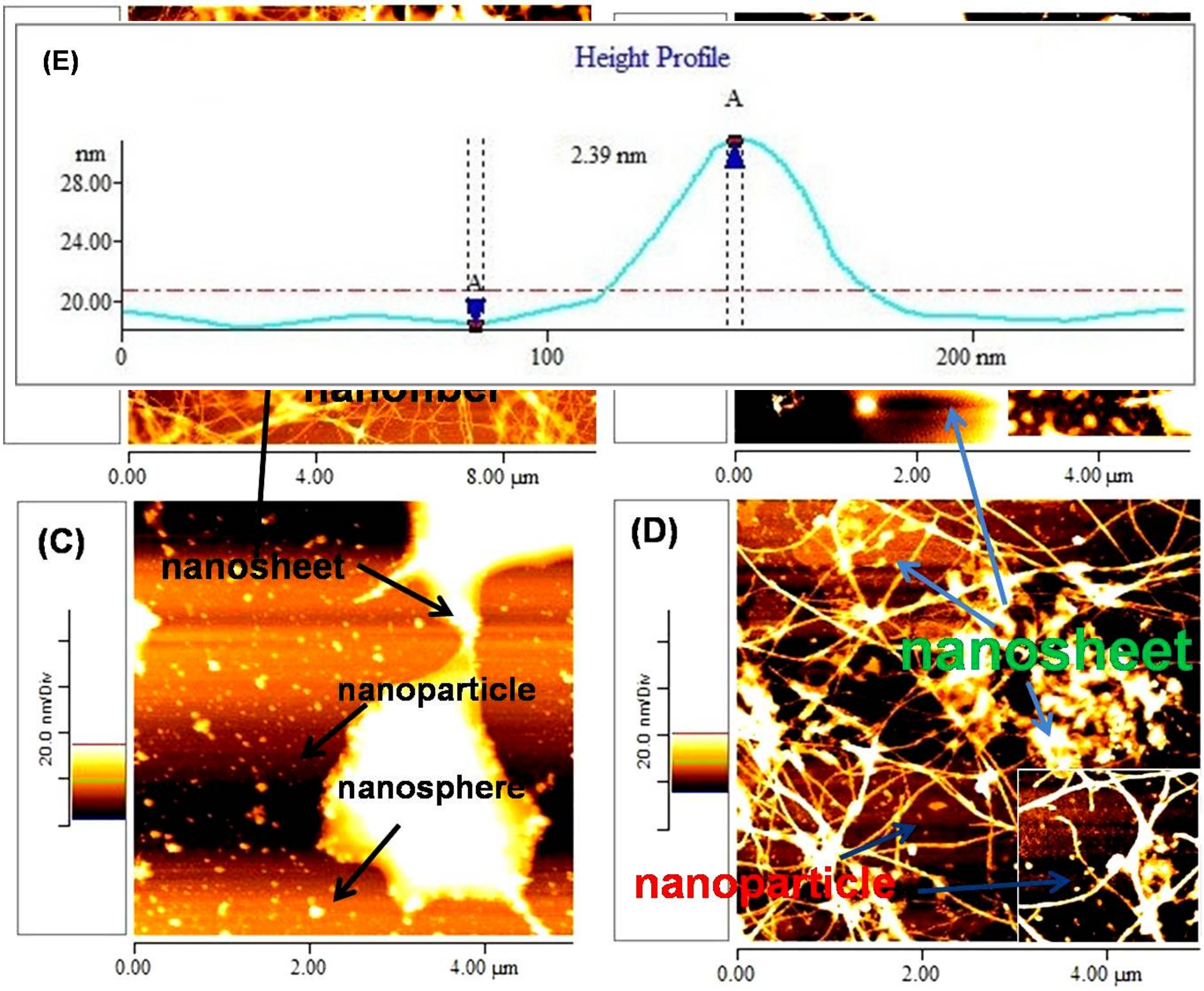

Fig. S5 AFM images of silver nanomaterial containing rGO based hydrogel (A) 15 minute of exposure in diffuse sunlight (Due to very tiny size of silver nanoclusters, these are unable to be visualised in that particular scale), (B) after 2.5 hour of exposure in diffuse sunlight, (C) after 5 hours of exposure in diffuse sunlight, and (D) after 20 minutes of exposure in direct sunlight. (E) Height profile diagram of the rGO taken from the Fig. S5 (D) indicating a few layer thickness of rGO nanosheet.

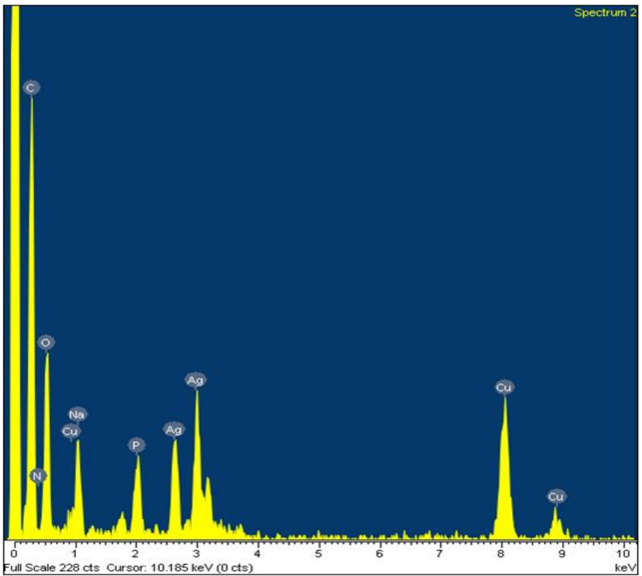

Fig. S6 EDX analysis of the silver nanomaterial containing hydrogel showing the presence of and silver.

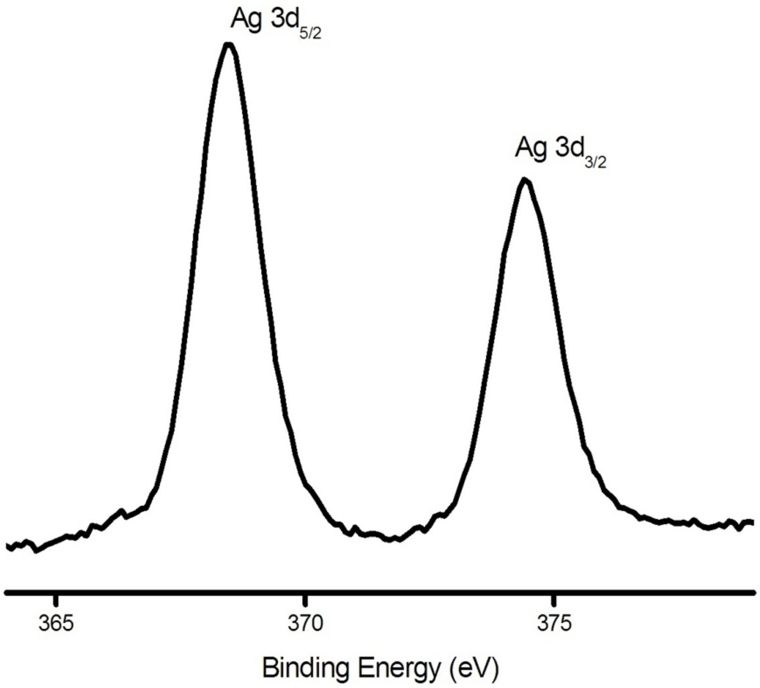

Fig. S7 XPS spectra of silver nanoparticle formation in presence of direct sunlight exposure for 20 minutes.

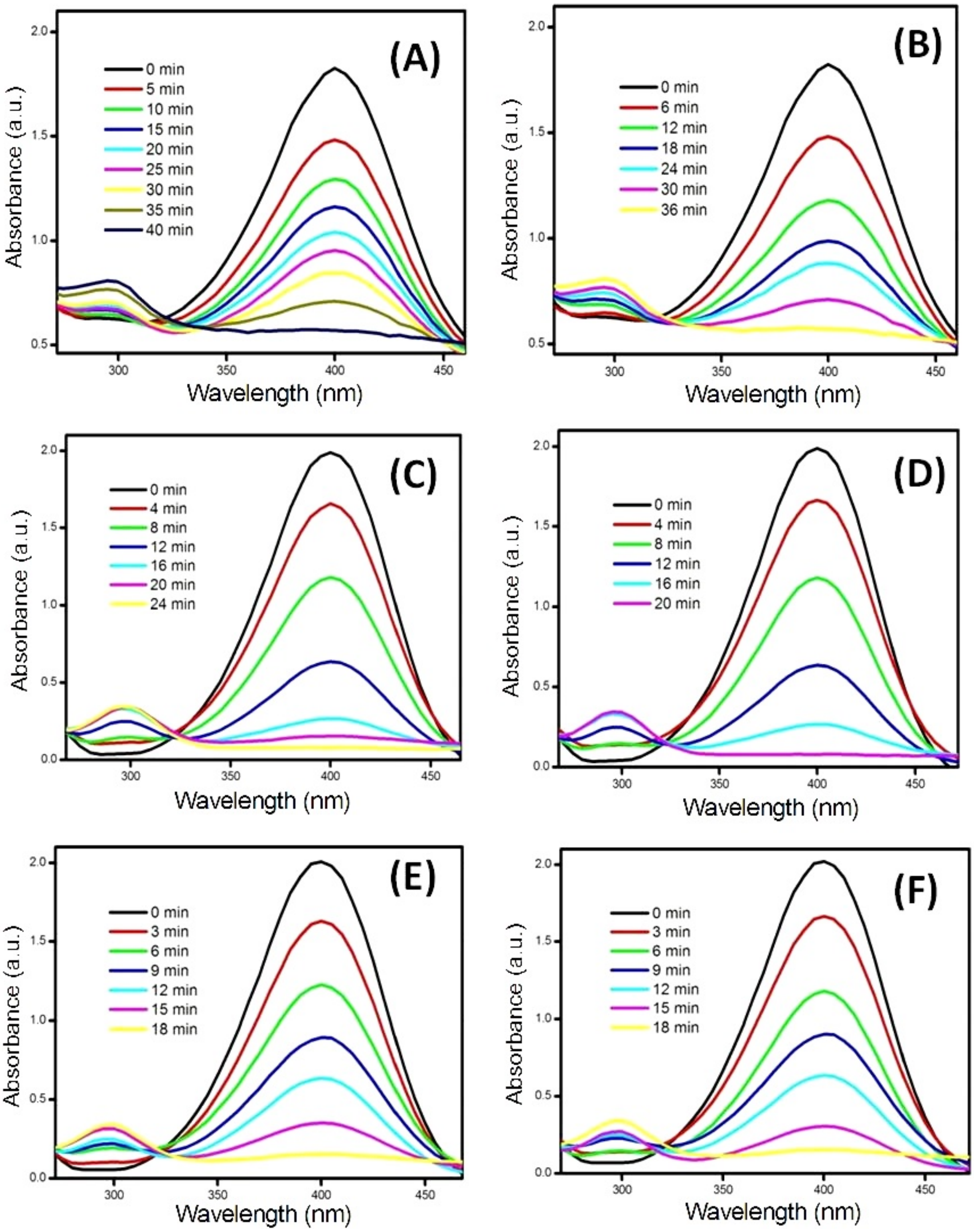

Fig. S8 UV/Vis absorption spectra of the catalytic reduction of *p*-nitrophenolate ion in presence of the catalyst under the diffused sunlight at different time intervals (A) and (B) 60 minute exposure, (C) and (D) 150 minute exposure, and (E) and (F) 300 minute exposure. The left panel is for silver nanoparticle containing native hydrogel (dried) catalyst (without rGO) and right panel is for silver nanoparticle containing rGO based hydrogel (dried) catalyst.

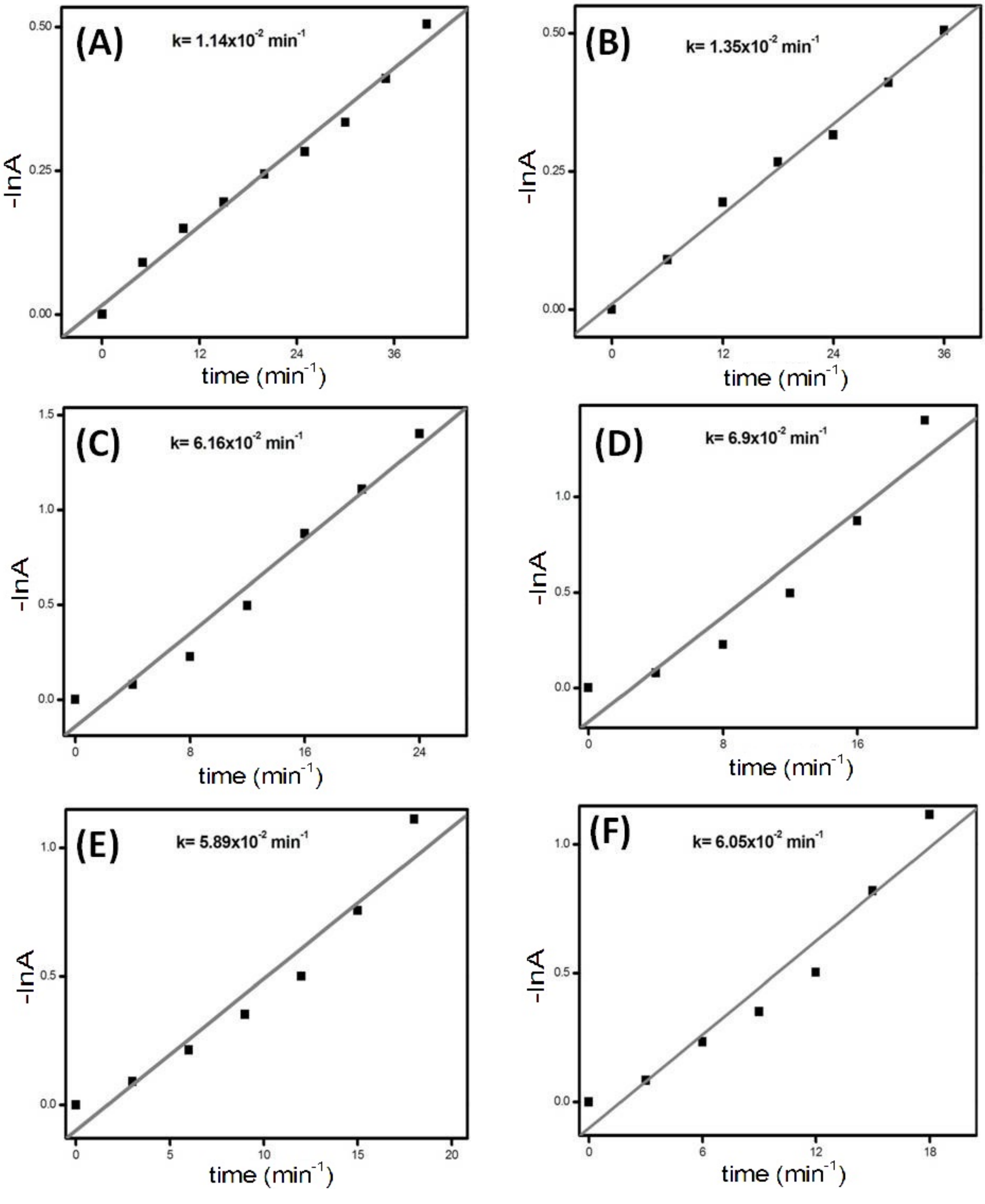

Fig. S9 Calculation of rate constant of *p*-nitrophenolate ion reduction in presence of the catalyst in diffused sunlight at various time intervals (A) and (B) 60 minute exposure, (C) and (D) 150 minute exposure, and (E) and (F) 300 minute exposure. The left panel is for silver nanoparticle containing native hydrogel (dried) catalyst (without rGO) and right panel is for silver nanoparticle containing rGO based hydrogel (dried) catalyst.

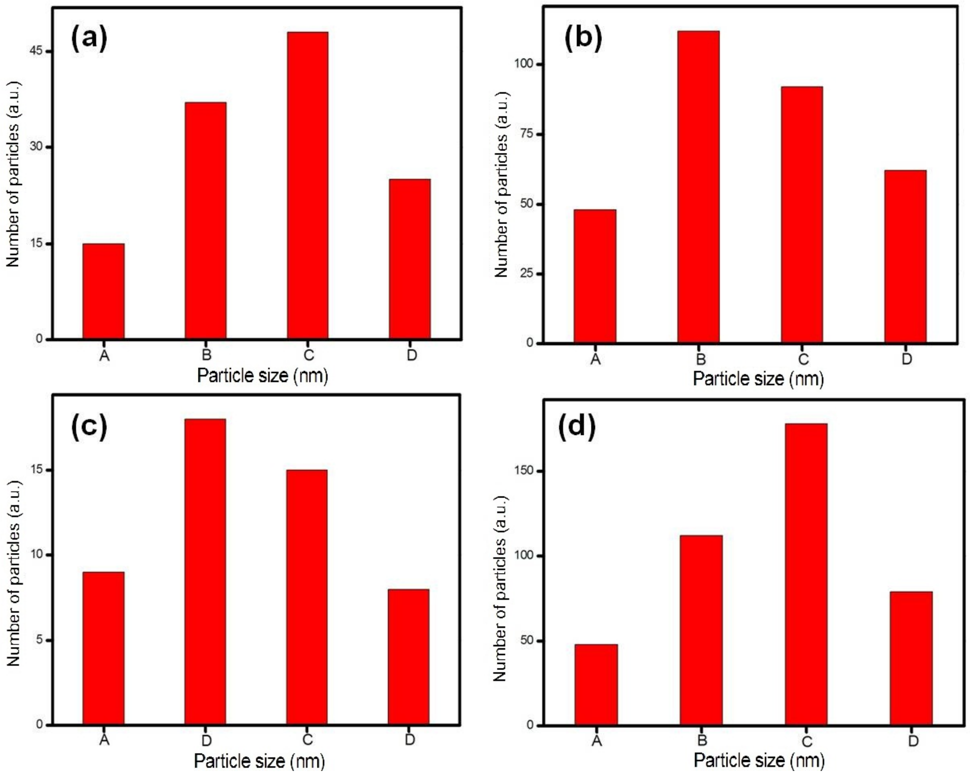

Fig. S10 Particle size distribution of silver nanomaterials form (a) after 15 minute exposure in diffused sunlight with their size (nm): A, B, C and D signify 0.3-0.59, 0.6-0.85, 0.86-1.52 and 1.53-1.92 respectively; (b) after 150 minute exposure in diffused sunlight with their size (nm): A, B, C and D signify 2.0-2.9, 3.0-4.0, 4.1-5.0 and 5.1-6.0 respectively; (c) after 300 minute exposure in diffused sunlight with their size (nm): A, B, C and D signify 8.0-9.5, 9.6-11.2, 11.3-15.0 and 15.1-19.4 respectively; (d) after 20 minute exposure in direct sunlight with their size (nm): A, B, C and D signify 10.0-11.9, 12.0-13.9, 14.0-17.0 and 17.1-20.5 respectively.

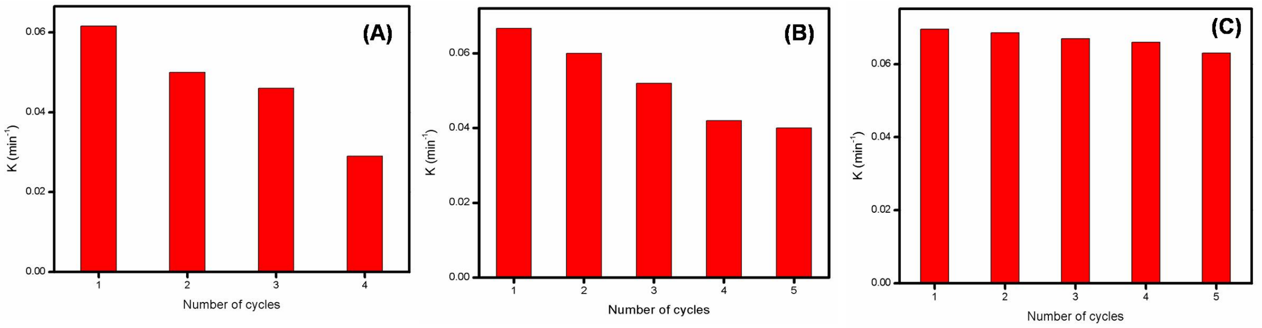

Fig. S11 Recyclability tests of the catalyst (A) silver nanoparticle containing native hydrogel (without rGO), (B) silver nanoparticle containing GO based gel and (C) silver nanoparticle containing rGO based gel after 150 minute of exposure in the reduction of *p*-nitrophenol.