Electronic Supplementary Information for

Enhanced thermal and energetic properties of NC-based nanocomposites with silane functionalized GO

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EXPERIMENTAL SECTION

Materials. 3-aminopropyltriethoxysilane (APTES) and 3-mercaptopropyl-trimethoxysilane (SPTES) were purchased from Sigma-Aldrich (China). GO were purchased from J&K Scientific (China). NC used in the study was industrial raw, and the nitrogen content of NC is 12.00±0.04%. All the chemicals used in this study were of analytical grade and they were used without further purification.

Characterization. The FTIR spectra were recorded at room temperature by using an infrared spectrometer (model Frontier Dual Ranger, PerkinElmer, USA) in attenuated total reflectance (ATR) mode from 650-4000 cm-1. Spectra were recorded at 4 cm-1 resolutions, and the reported spectra are the average of 64 scans.

Raman spectra were measured with a in via spectrometer using a (λ=514 nm).

X-ray photoelectron spectroscopy (XPS) was carried out by using a spectrometer Escalab 250Xi (Thermo Fisher Scientific Ltd, East Grinstead, UK) equipped with a monochromatized A1 Ka source and a 6-channeltron detector. A standard electromagnetic lens mode with analysis area of about 1 mm in diameter was used together with 20 eV pass energy of analyzer, ensuring the resolution in energy of 0.3-5 eV. To eliminate the sample charging, two low-energy flood sources (in-lens electron beam and external Ar ion beam) were used. Final calibration of binding energy (BE) scale was done by fixing the main component of C is peak (C-C bonds) at 284.0 eV. The peak fitting of XPS spectra has been performed by using Shirley

background, Voigt peak-shape (mixed Gaussian-Lorentzian with variable ratio) and linked full widths at half maximum (FWHMs) for the same core level.

The morphological analysis of NC composites was performed by SEM analysis. In particular, a FEI Quanta 200 FEG scanning electron microscope (ESEM) (FEI, Eindhoven, The Netherlands) in high vacuum mode by using an accelerating voltage within 10 -20 kV range and a secondary electron detector (Everhart-Thornley detector) were used for SEM analysis. Before the analysis, dried specimens were mounted on aluminium stubs by means of carbon adhesive disks and coated with a thin layer (about 10 nm thick) of an Au-Pd alloy by means of an Emitech K575 sputter coating system (Quorum Technologies LTD, Ashford, UK).

The thermal properties of NC composites were studied using a simultaneous TGA-DSC. Instrument (STA449 F5, NETZSCH, Germany) with 40 mL/min of argon flow from 50 to 400 ^{o}C at a heating rate of 10 ^{o}C/min. To ensure the reproducibility of the DSC results, the temperature and calorimeter sensitivity calibrations are conducted before running DSC tests. Temperature calibration was performed using the melting transition of five pure metal standards (In, Sn, Zn, Al and Ag, all 99.99+ purity). Four measurements of the melting onset temperature were made for each standard at a scan rate of 10 ^{o}C/min. The calorimeter sensitivity was determined via the "Cp method" measuring the heat capacity of a sapphire standard reference material at the scan rate of 10 ^{o}C/min.

The heat of reaction was measured by means of standard oxygen bomb calorimetry (ZDHWHN7000C, Huaneng Keji Co., Ltd., China) with an argon pressure of 3.0 MPa.

Preparation. *Preparation of NC/GO nanocomposites.* NC was added in THF (40 mL) and stirred for 2 h. GO dispersion (0.1 mg/mL) was mixed with NC solution. The mix were stirred for 30 min at 30 oC and sonicated for 5 min. The resulting dispersion was poured into a teflon plate and air-dried to allow solvent removal. The obtained film was peeled off and thermally treated at 50 oC for 1 h under vacuum before further characterization. Three different GO amounts, namely 0.25, 0.5 and 1 wt.% with respect to the polymer were used for the preparation of GO-based composites,

coded as NC/GO/0.25, NC/GO/0.5 and NC/GO/1.

Preparation of NC/SiGO nanocomposites. NC was added in THF (40 mL) and stirred for 2 h. NH-SiGO(SH-SiGO) dispersion (0.1 mg/mL) was mixed with NC solution. The mix were stirred for 30 min at 30 ^{o}C and sonicated for 5 min. The resulting dispersion was poured into a teflon plate and air-dried to allow solvent removal. The obtained film was peeled off and thermally treated at 50 ^{o}C for 1 h under vacuum before further characterization. Three different NH-SiGO(SH-SiGO) amounts, namely 0.25 wt.%, 0.5 wt.% and l wt.% with respect to the polymer were used for the preparation of SiGO-based composites, coded as NC/NH-SiGO/0.25 (NC/SH-SiGO/0.25), NC/NH-SiGO/0.50 (NC/SH-SiGO/0.50), and NC/NH-SiGO/1 (NC/SH-SiGO/1).

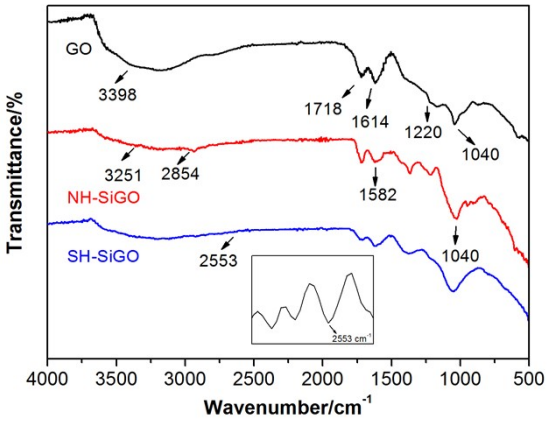

Fig. S1 FTIR spectra of GO, NH-SiGO and SH-SiGO

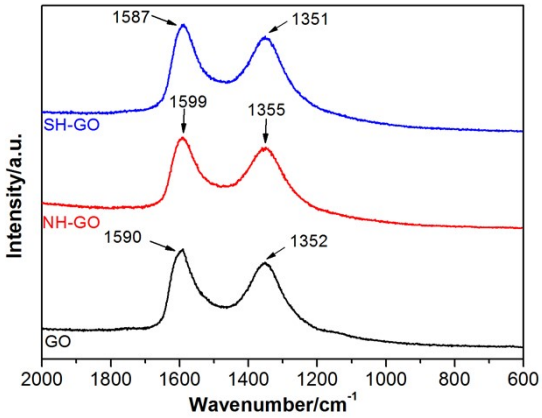

Fig. S2 FT-Raman spectra of GO, NH-SiGO and SH-SiGO

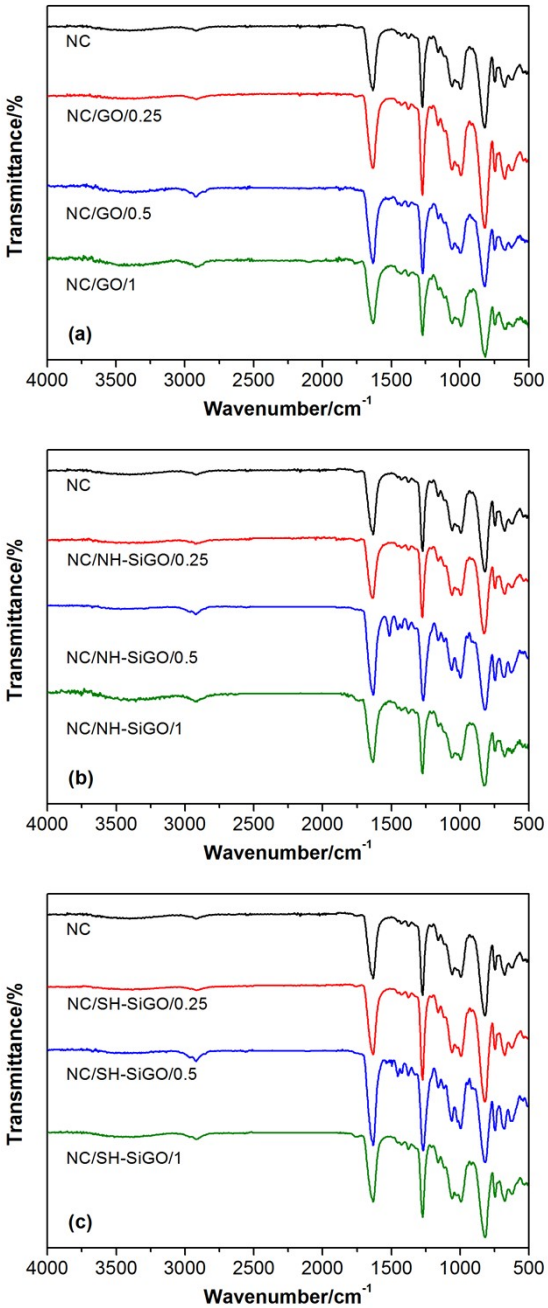

Fig. S3 FTIR spectra of (a) NC/GO composites, (b) NC/NH-SiGO composites and (c) NC/SH-SiGO composites

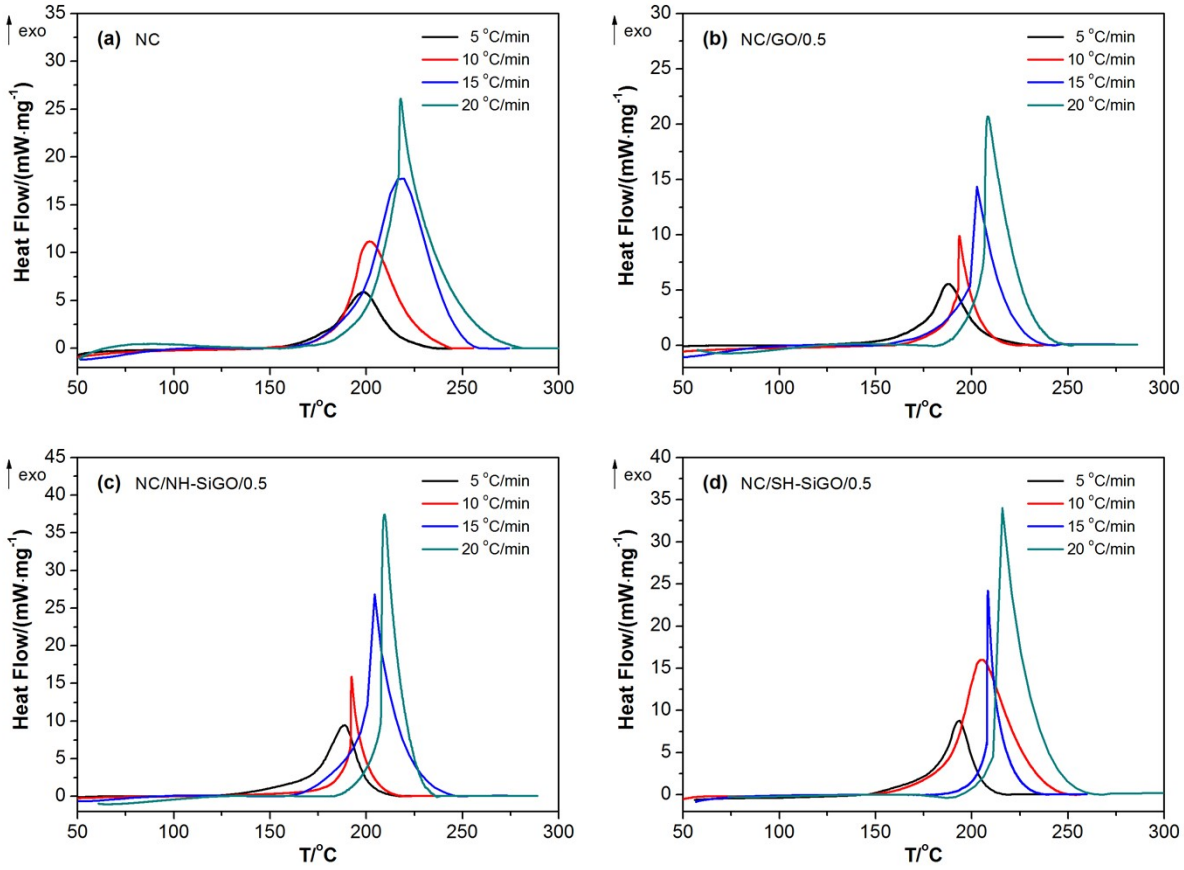

Fig. S4 Thermal kinetic curves for (a) NC, (b) NC/GO/0.5, (c) NC/NH-SiGO/0.5 and (d) NC/SH-SiGO/0.5

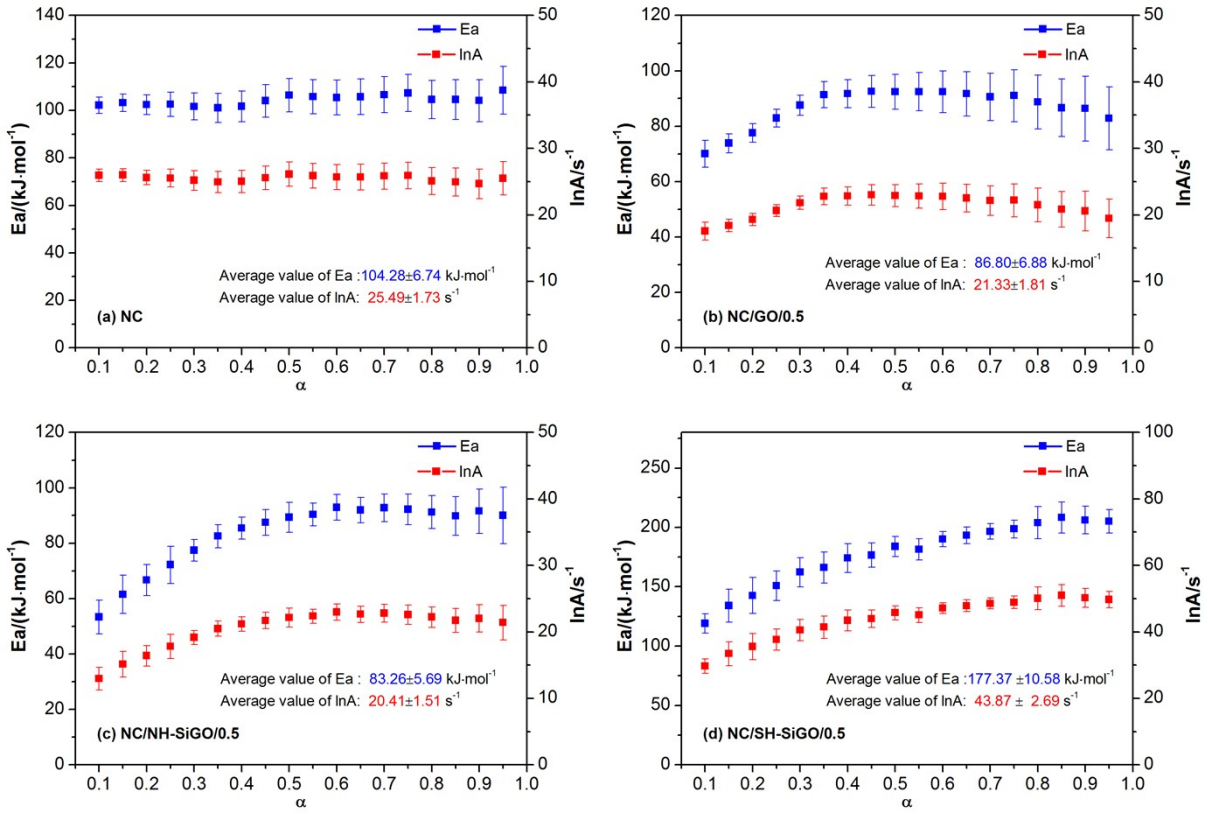

Fig. S5 Kinetic plots for (a) NC, (b) NC/GO/0.5, (c) NC/NH-SiGO/0.5 and (d) NC/SH-SiGO/0.5 by KAS isoconversional method

Table S1 Thermal kinetic results for NC and its composites

	NC		NC/ GO/0.5		NC/NH-SiGO/0.5		NC/SH-SiGO/0.5	
	Ea/(kJ·mol^{-1})	lnA/s^{-1}	Ea/(kJ·mol^{-1})	lnA/s^{-1}	Ea/(kJ·mol^{-1})	lnA/s^{-1}	Ea/(kJ·mol^{-1})	lnA/s^{-1}
0.10	102.17±3.42	25.93±0.91	70.05±4.93	17.55±1.36	53.31±6.12	12.95±1.72	119.04±8.13	29.68±2.12
0.15	103.18±3.66	25.97±0.97	73.80±3.44	18.39±0.94	61.54±6.94	15.11±1.92	134.01±13.86	33.45±3.59
0.20	102.37±4.11	25.59±1.09	77.55±3.38	19.28±0.91	66.70±5.62	16.40±1.54	142.51±15.15	35.55±3.91
0.25	102.54±5.06	25.52±1.33	82.90±3.24	20.64±0.87	72.19±6.67	17.80±1.81	150.86±12.46	37.63±3.20
0.30	101.61±5.66	25.18±1.48	87.53±3.61	21.82±0.97	77.41±3.90	19.13±1.05	162.26±12.36	40.51±3.17
0.35	101.05±6.12	24.94±1.60	91.34±4.71	22.77±1.25	82.52±4.23	20.46±1.13	166.13±13.13	41.43±3.36
0.40	101.63±6.53	25.01±1.70	91.71±5.05	22.82±1.34	85.39±3.98	21.18±1.06	174.09±12.27	43.41±3.13
0.45	104.00±6.83	25.56±1.77	92.57±5.76	22.99±1.53	87.51±4.62	21.69±1.23	176.59±10.25	43.97±2.61
0.50	106.37±7.08	26.11±1.83	92.42±6.28	22.89±1.66	89.33±5.42	22.13±1.44	183.87±8.40	45.75±2.14
0.55	105.72±7.18	25.85±1.85	92.42±6.90	22.84±1.82	90.38±4.04	22.35±1.07	181.46±8.82	45.04±2.24
0.60	105.39±7.36	25.68±1.89	92.39±7.52	22.77±1.98	92.92±4.65	22.97±1.23	190.07±6.39	47.14±1.62
0.65	105.67±7.51	25.67±1.93	91.71±7.99	22.52±2.10	91.91±4.64	22.64±1.22	193.27±6.98	47.84±1.76
0.70	106.57±7.62	25.82±1.95	90.55±8.52	22.14±2.23	92.72±5.03	22.79±1.32	196.53±6.64	48.53±1.67
0.75	107.26±7.79	25.90±1.98	90.97±9.42	22.17±2.46	92.20±5.56	22.56±1.45	198.53±7.58	48.89±1.90
0.80	104.54±8.07	25.08±2.05	88.72±9.69	21.47±2.52	91.23±5.92	22.21±1.54	203.89±13.58	50.05±3.40
0.85	104.51±8.32	24.94±2.10	86.62±10.39	20.8±2.69	89.81±6.99	21.72±1.81	208.26±13.02	50.96±3.24
0.90	104.10±8.88	24.66±2.23	86.36±11.69	20.59±3.01	91.53±7.94	22.02±2.04	206.17±11.59	50.20±2.88
0.95	108.44±10.06	25.49±2.50	82.80±11.33	19.46±2.89	90.03±10.18	21.38±2.59	205.21±9.90	49.67±2.44
Average value	104.28±6.74	25.49±1.73	86.80±6.88	21.33±1.81	83.26±5.69	20.42±1.51	177.38±10.58	43.87±2.69