Electronic Supplementary Information

Transferring Waste Papers to Multifunctional Graphene-Decorated Carbon Papers: From Trash to Treasure

Tian-Nan Ye, Wei-Jie Feng, Bing Zhang, Miao Xu, Li-Bing Lv, Juan Su, Xiao Wei, Kai-Xue Wang, Xin-Hao Li and Jie-Sheng Chen**

School of Chemistry and Chemical Engineering, Shanghai Jiao Tong University, Shanghai 200240 (P. R. China).
*Address correspondence to xinhaoli@sjtu.edu.cn; chemcj@sjtu.edu.cn.

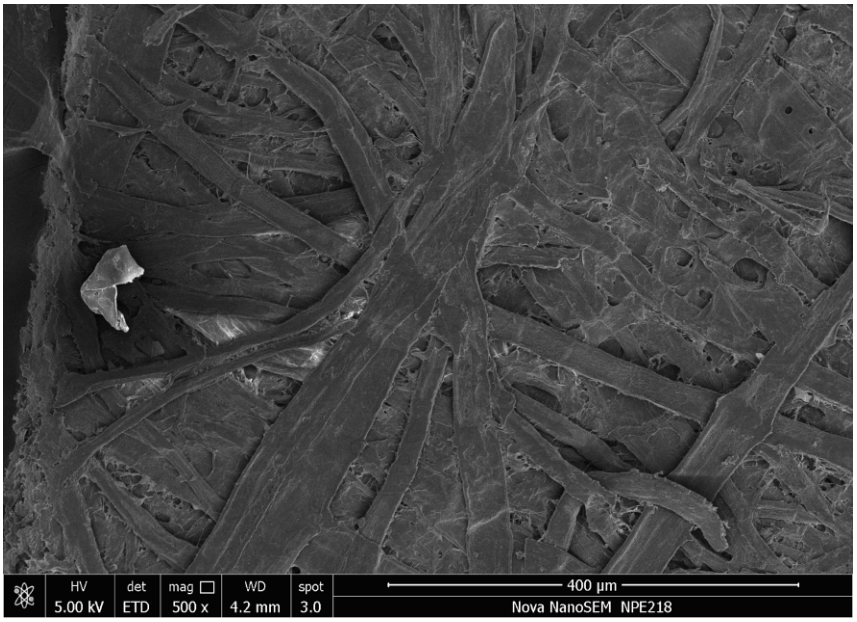


Fig. S1 Large-area SEM image of typical waste paper. The papers are composed of cellulose fibers with the average diameters of 15-30 µm.

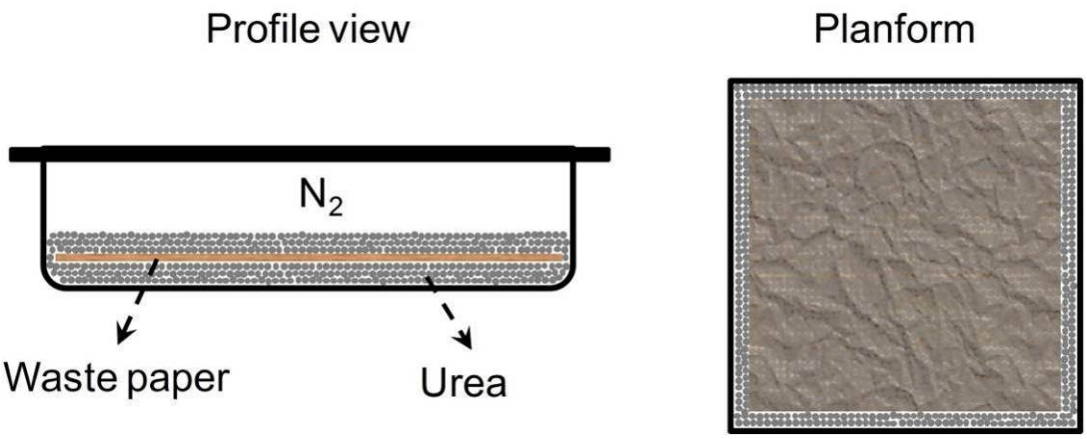


Fig. S2 Synthesis procedure for GCCP composites. Typically, a piece of waste paper was directly loaded into a cubic crucible with upper and lower floors covering urea and then pyrolyzed at 1000 ^{o}C under nitrogen gas atmosphere.

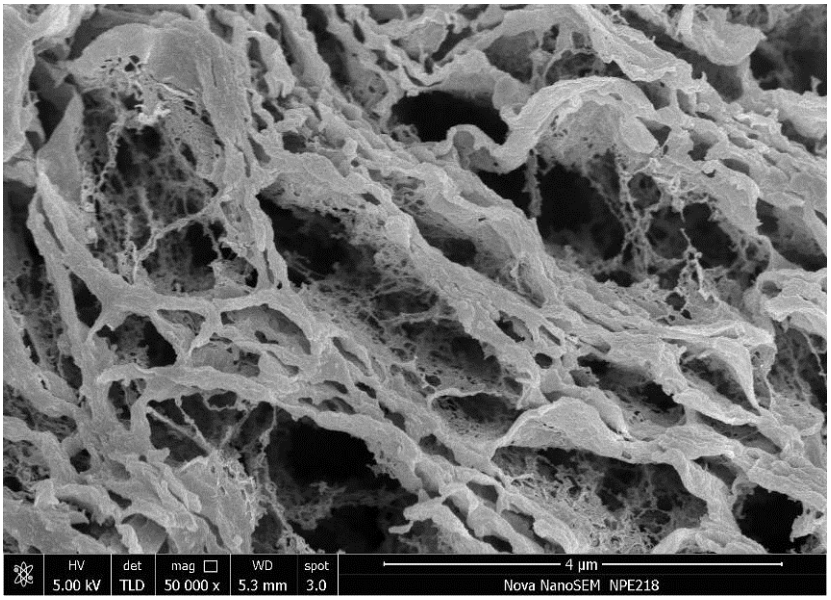


Fig. S3 SEM image of graphene@carbon nanofiber/g-C_3N_4 composite obtained at 600 °C. The carbonized cellulose fibers were confined in the interlayer voids of g-C_3N_4.

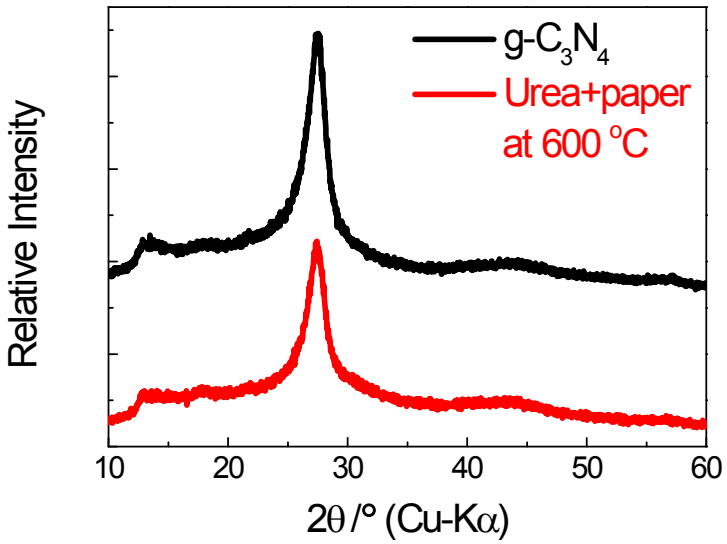


Fig. S4 XRD pattern of g-C_3N_4 and graphene@carbon nanofiber/g-C_3N_4 composite obtained at 600 °C. The typical layered structure of g-C_3N_4 can be observed, indicating the well development of polymeric plane of carbon nitride.

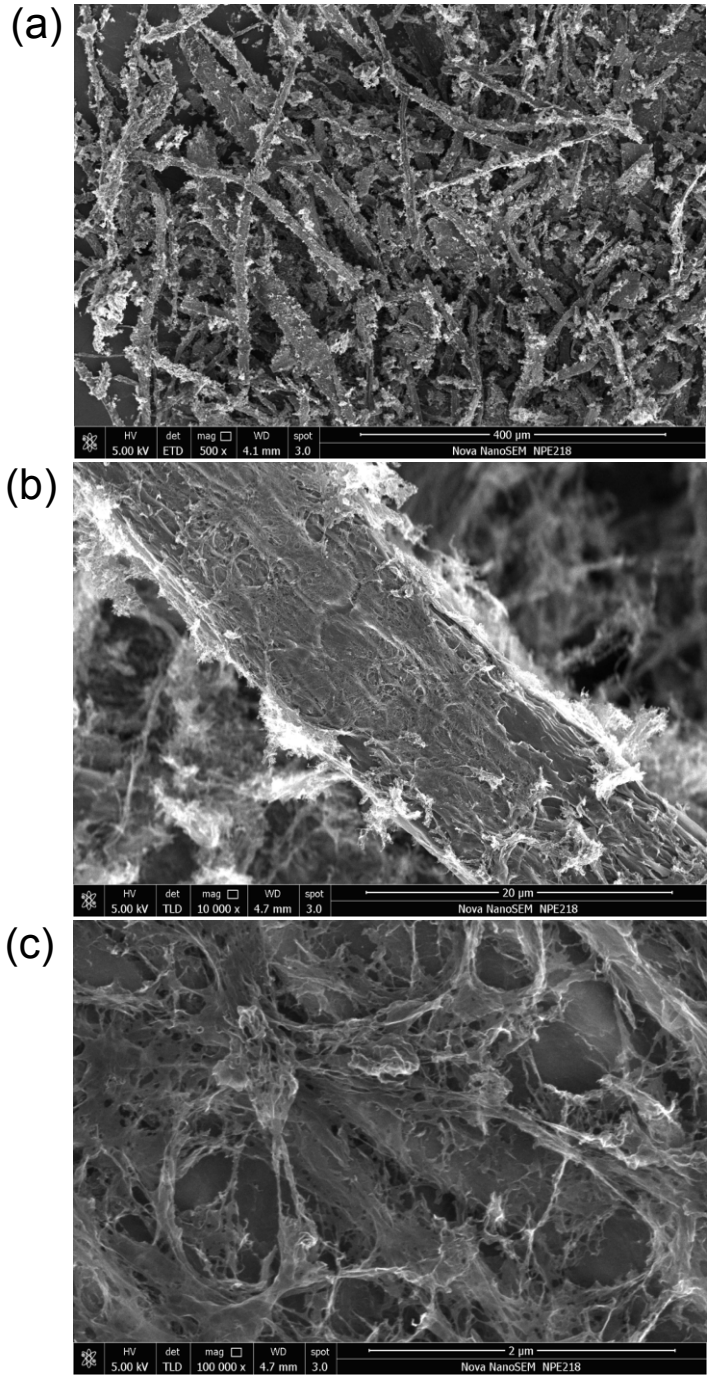


Fig. S5 Large-area (a) and amplified (b-c) SEM images of GCCP (precursor: A4 paper). Graphene sheets formed in-situ on the surface of carbon nanofibers without disturbing the primary structure of paper fibers too much.

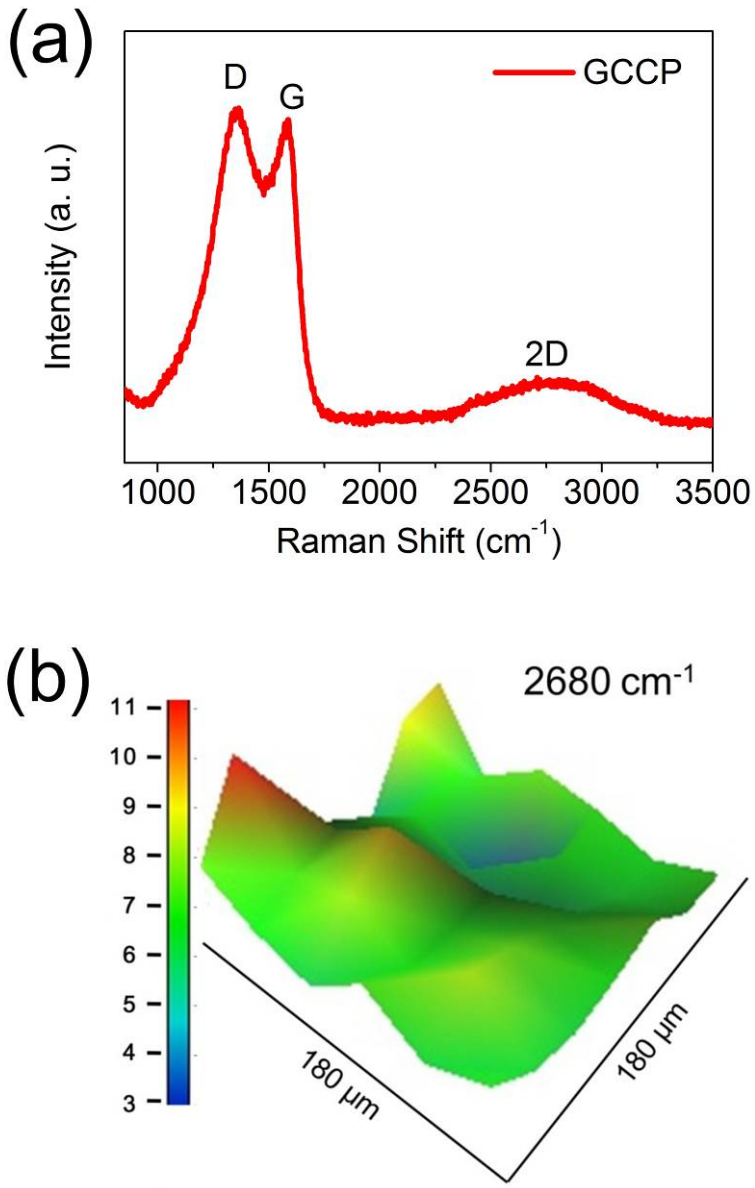


Fig. S6 Raman spectra (a) and corresponding 3D mapping (b) of graphene 2D band (2680 cm^{-1}) in GCCP. Raman spectrum (a) of GCCP with a typical 2D-band of graphene centered at 2680 cm^{-1}. From the 3D mapping images (b) of graphene 2D band, the uniform distribution of graphene across over the surface of the whole paper was confirmed.

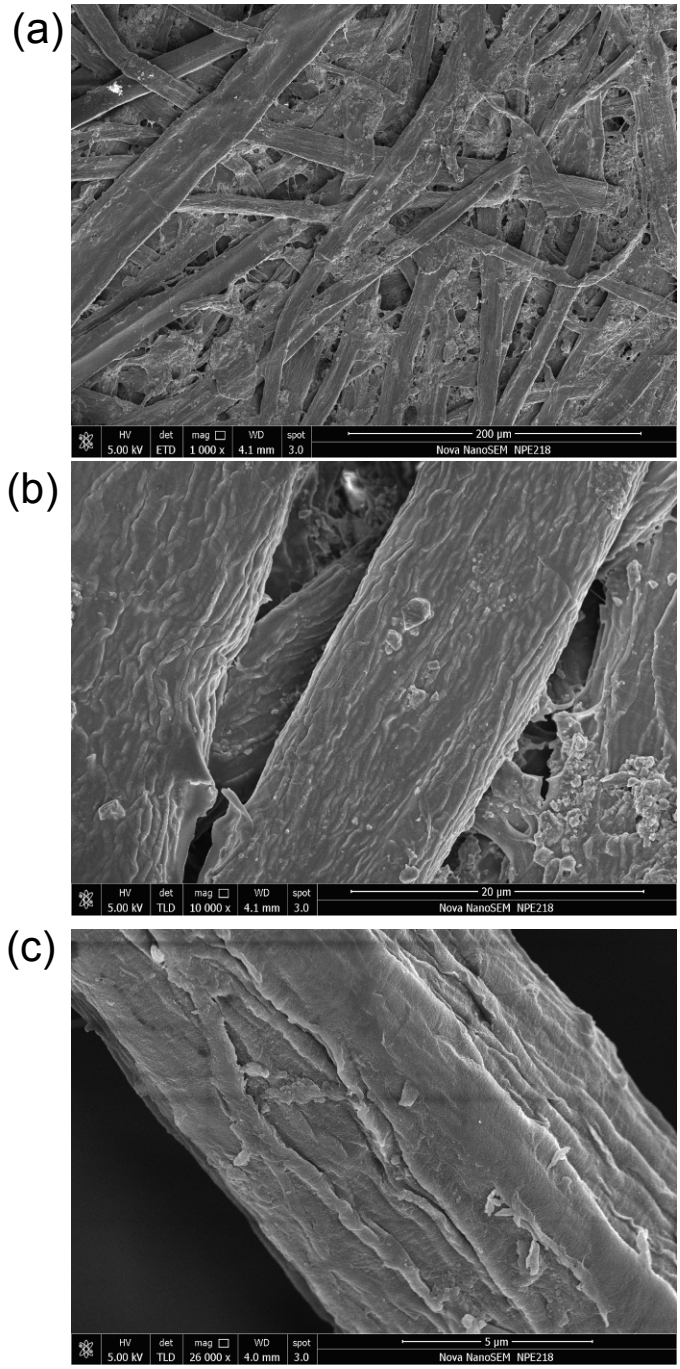


Fig. S7 Large-area (a) and amplified (b-c) SEM images of carbonized paper without the assistance of urea (Precursor: A4 paper). The carbonized paper maintained the original fiber structure of the cellulose without formation of graphene sheets on the surface.

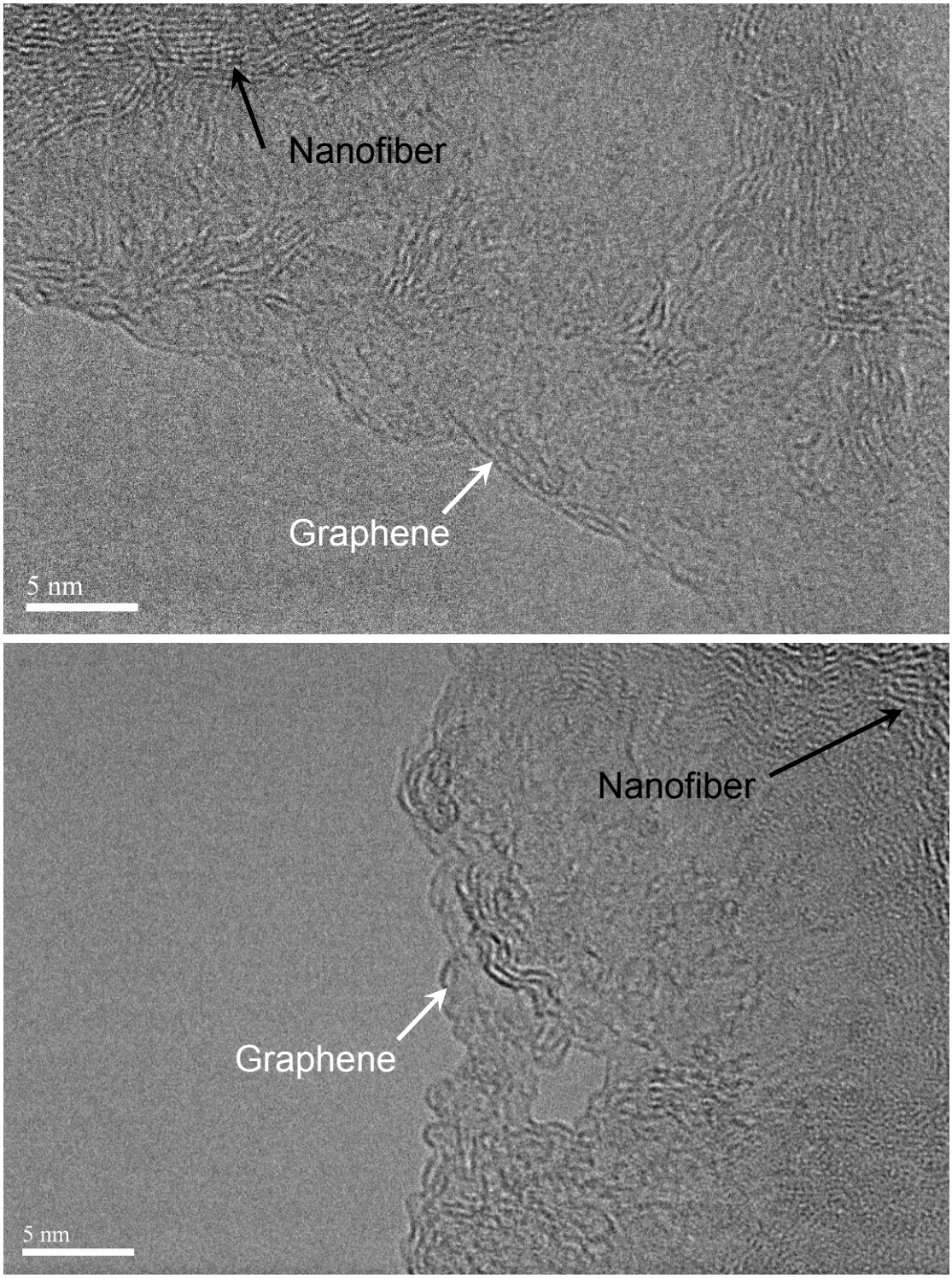


Fig. S8 High-magnification TEM images of the surface graphene integrated carbon nanofiber composite. The layer number of the graphene was estimated to be 1-7.

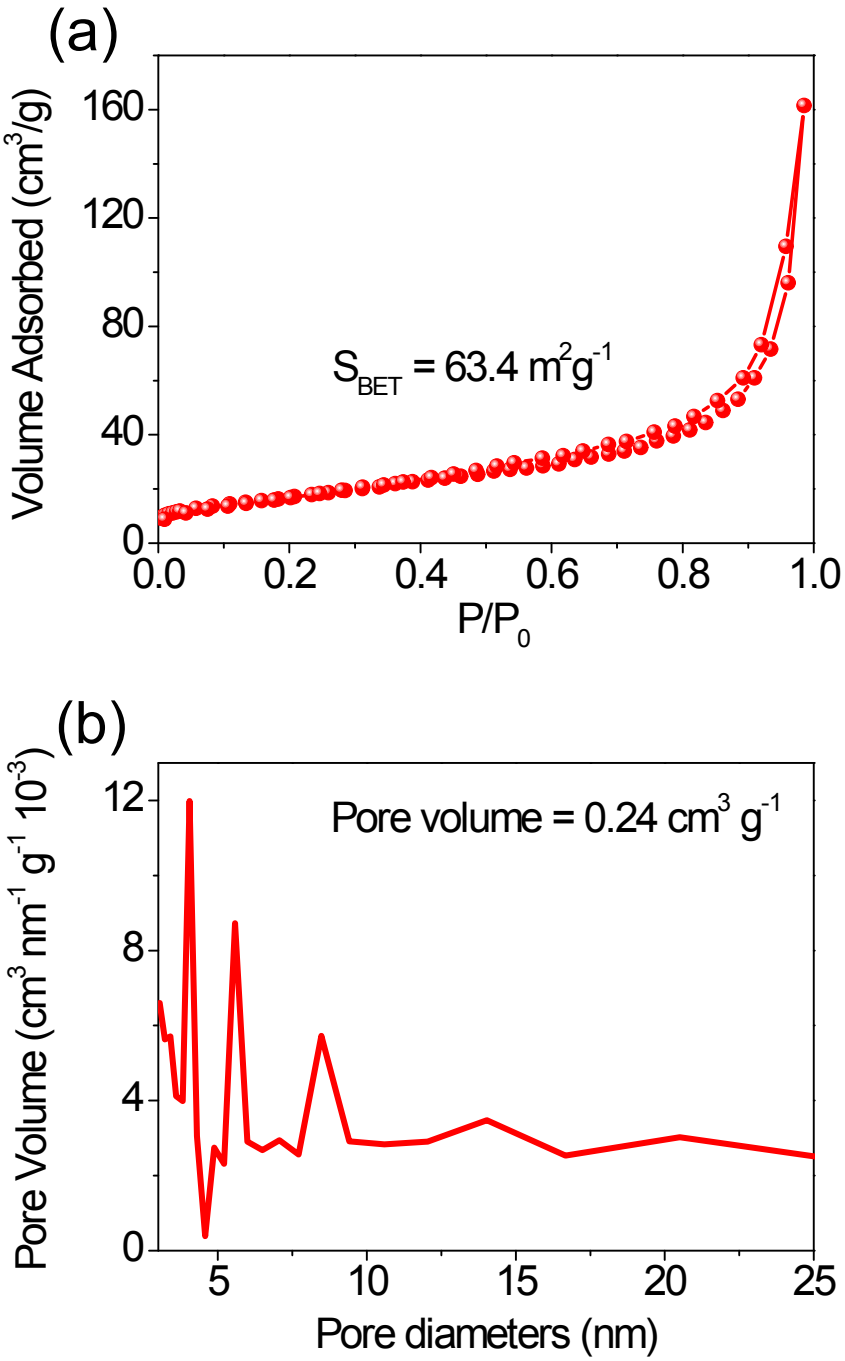


Fig. S9 Nitrogen adsorption–desorption isotherms (a) and pore size distribution (b) of GCCP. The specific surface area of GCCP is 63.4 $m^2 g^{-1}$ and the pore volume is 0.24 $cm^3 g^{-1}$.

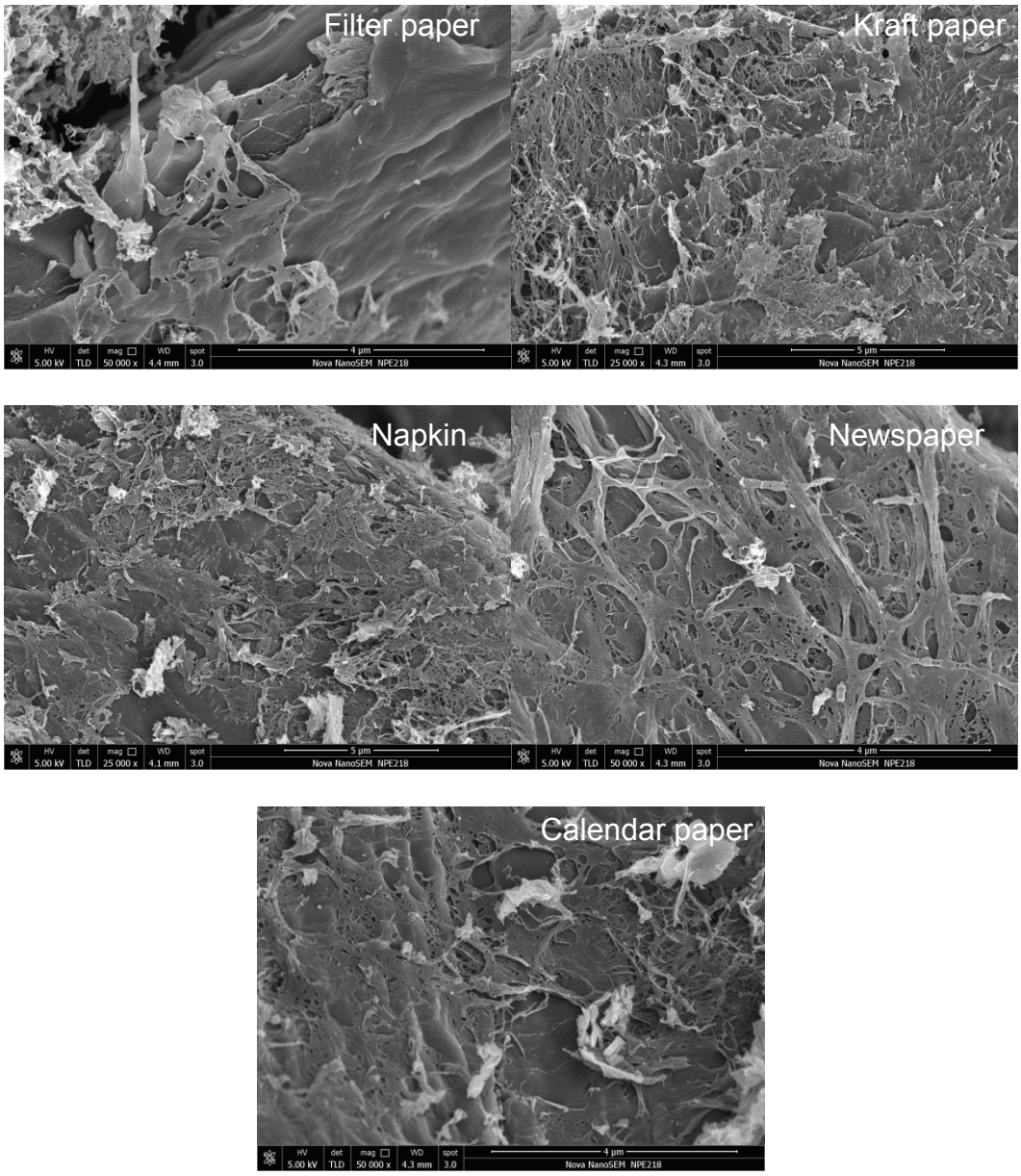
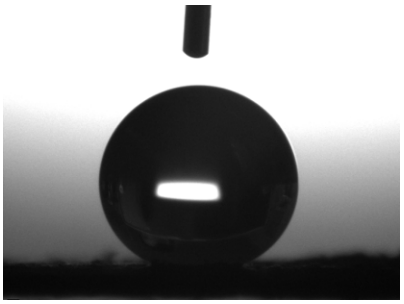
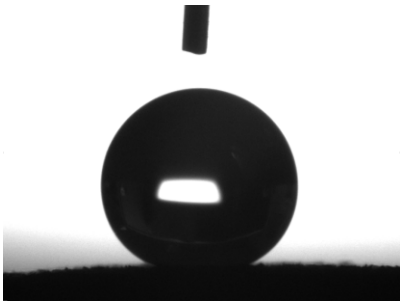
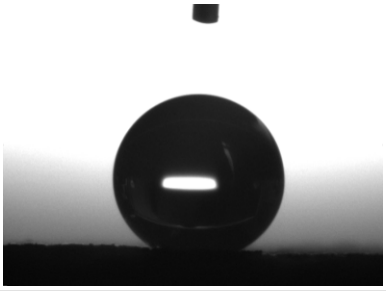
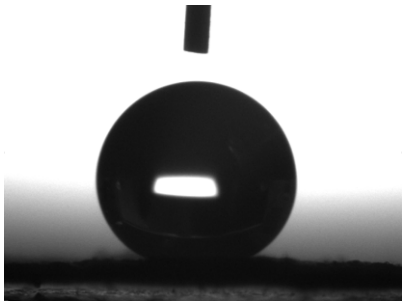
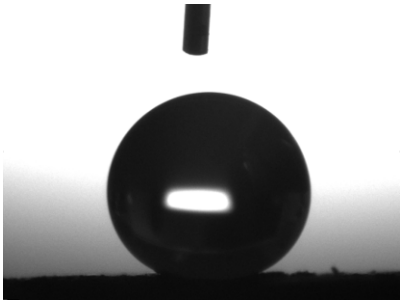


Fig. S10 High-magnification SEM images of GCCP samples obtained from various waste papers. The hierarchical structure of graphene-carbon fiber composite paper can be seen in all these samples.

Table S1 Wettability list of GCCP samples obtained from various waste papers.

Precursor	Images	Contact angle
Filter paper		154.3±2.8°
Kraft paper		158.3±2.4°
Napkin		152.7±2.1°
Newspaper		154.3±3.0°
Calendar paper		154.6±3.3°

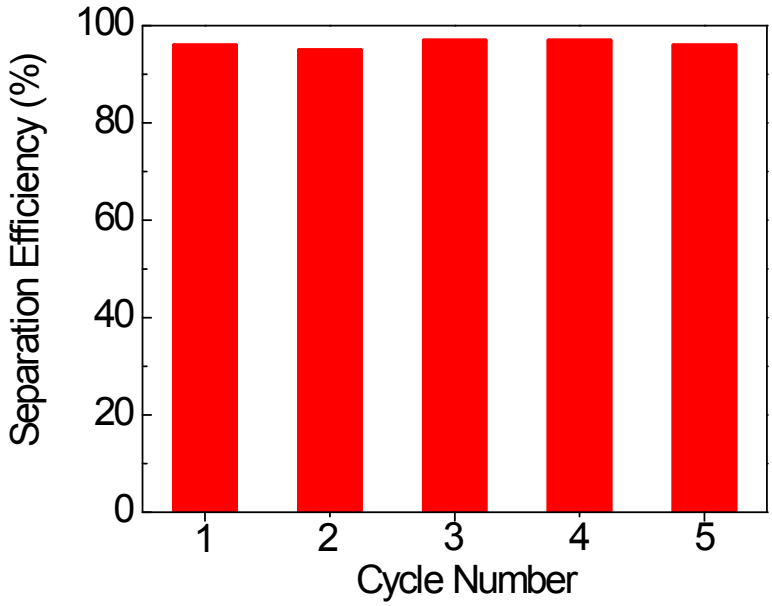


Fig. S11 The cycle stability of the separation efficiency of carbon tetrachloride/water mixtures through GCCP. No obvious decrease in the separation efficiency was observed in the following five runs.

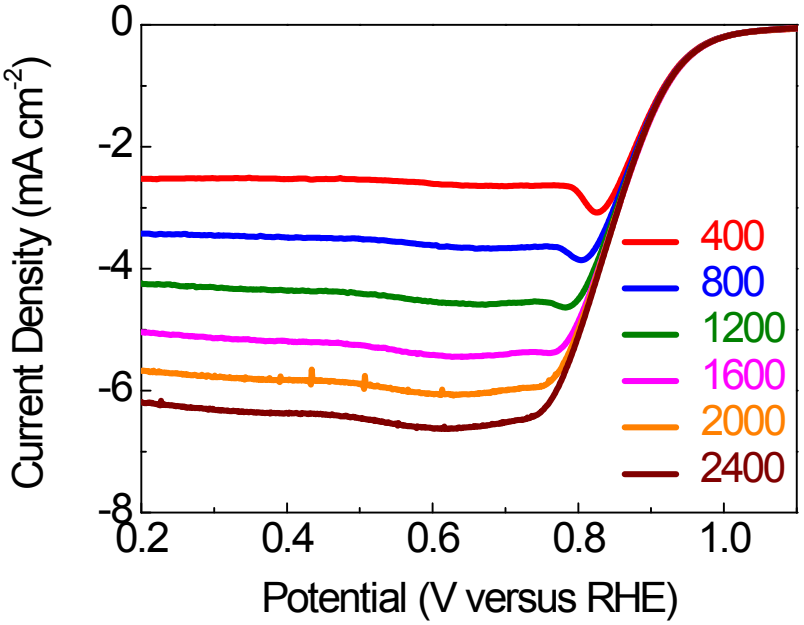


Fig. S12. Polarization curves of GCCP-Pt sample on glassy carbon electrodes in O_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1} at different RDE rotation rates (in rpm).

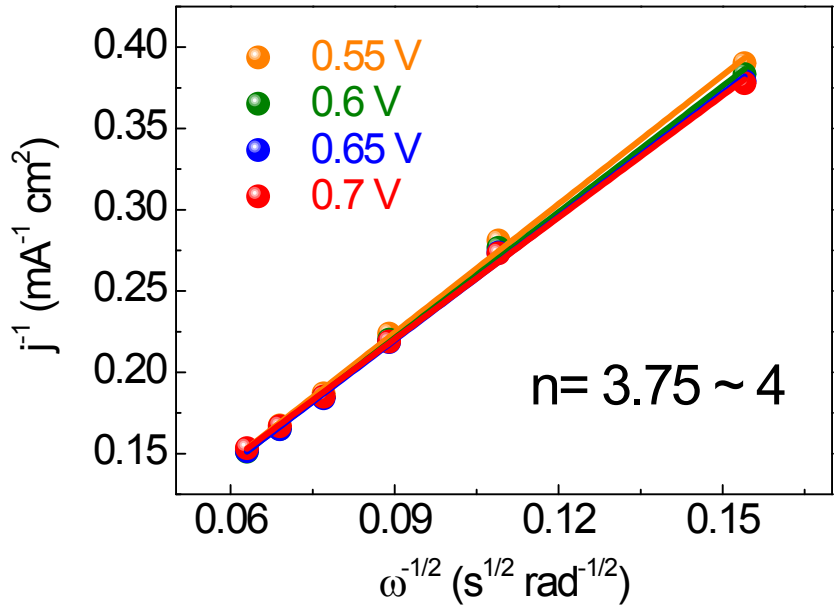


Fig. S13. Koutecky–Levich plots (J^{-1} versus $\omega^{-1/2}$) of GCCP-Pt sample at different electrode potentials vs RHE, showing the nearly four electron transfer process.

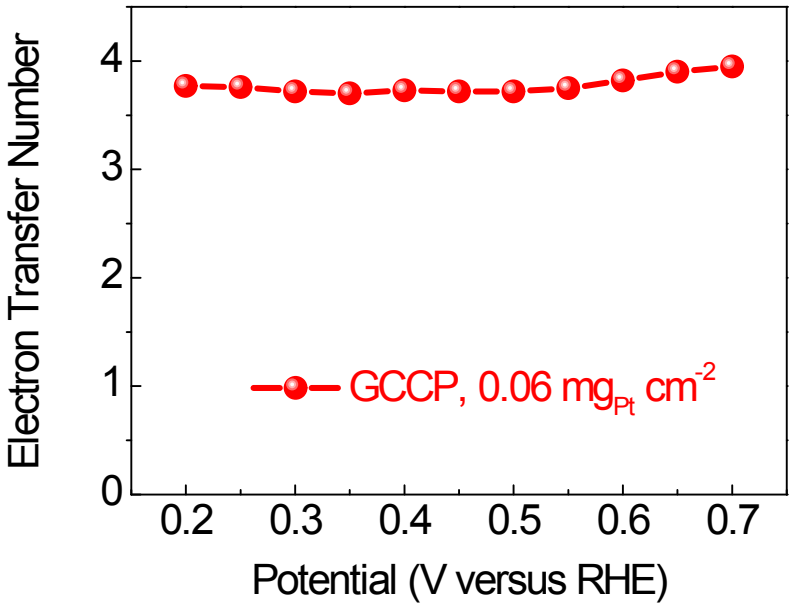


Fig. S14. Electron transfer numbers as a function of the overpotential of GCCP-Pt sample.

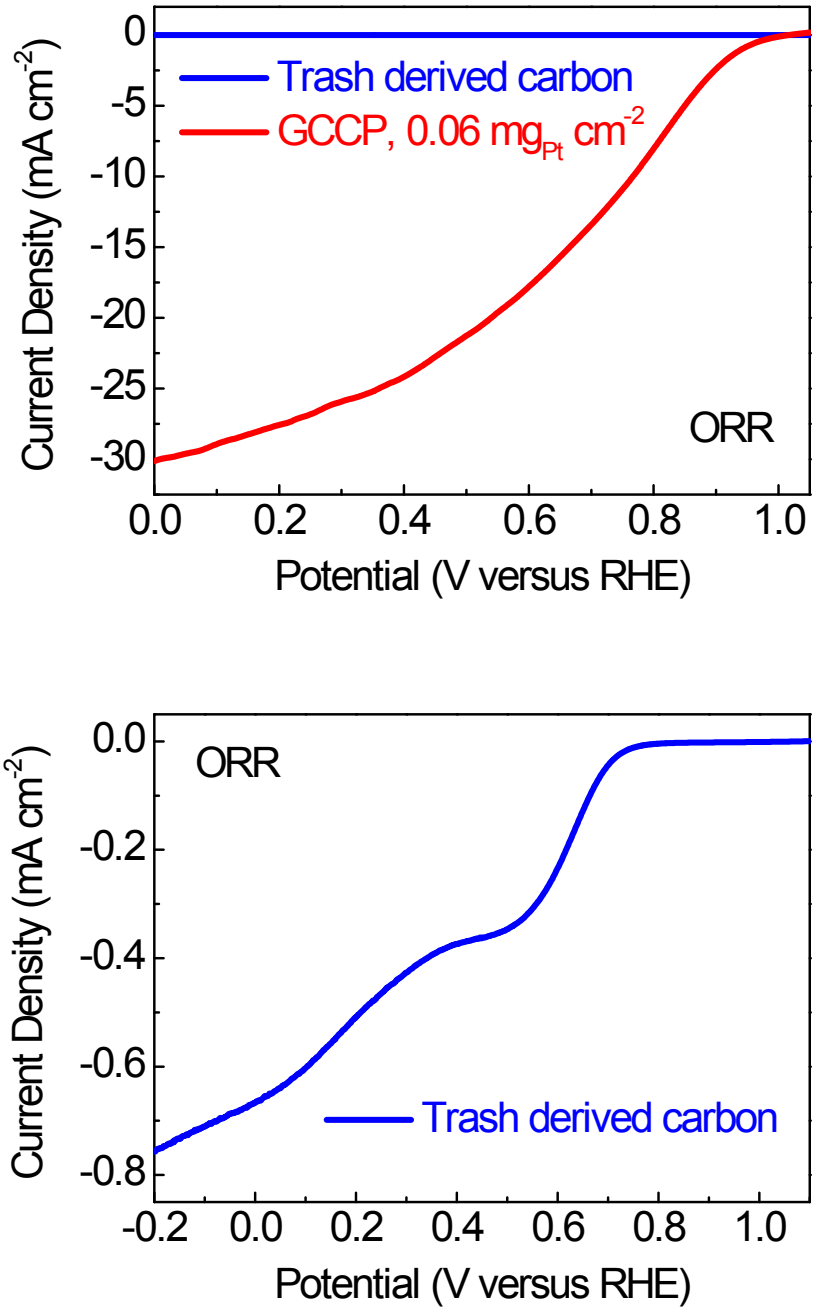


Fig. S15 Polarization curves of GCCP-Pt and trash derived carbon in O_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1}.

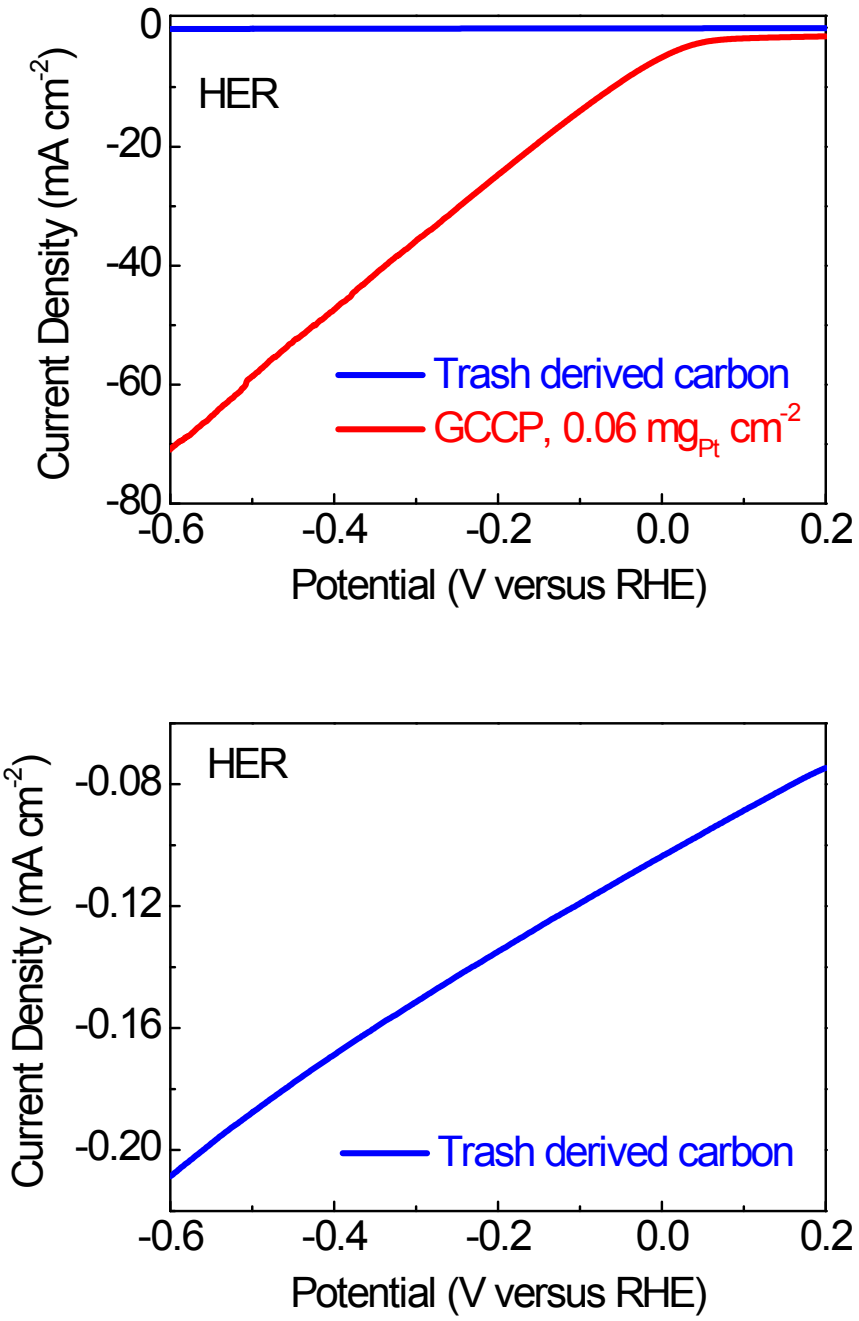


Fig. S16 Polarization curves of GCCP-Pt and trash derived carbon in N_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1}.

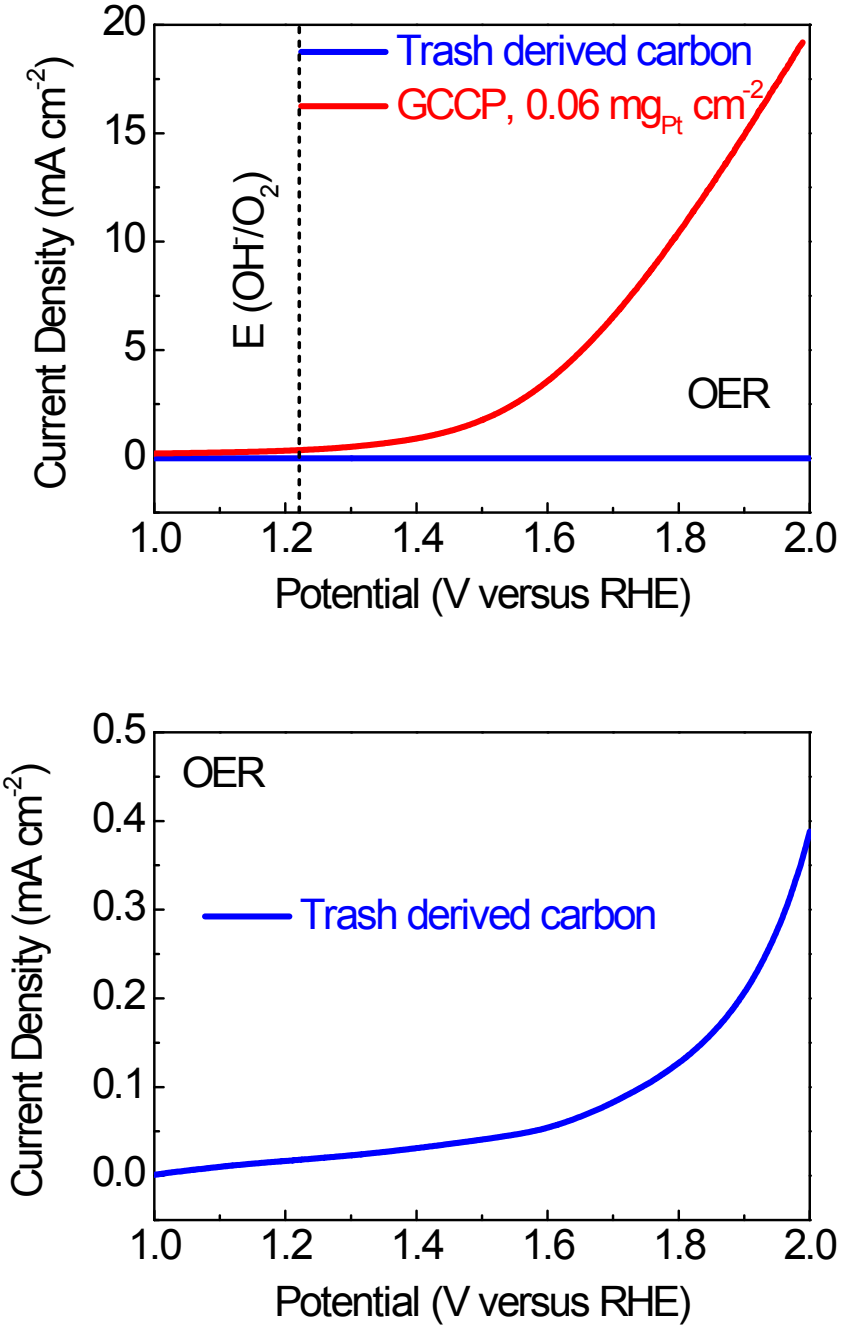


Fig. S17 Polarization curves of GCCP-Pt and trash derived carbon in N_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1}.

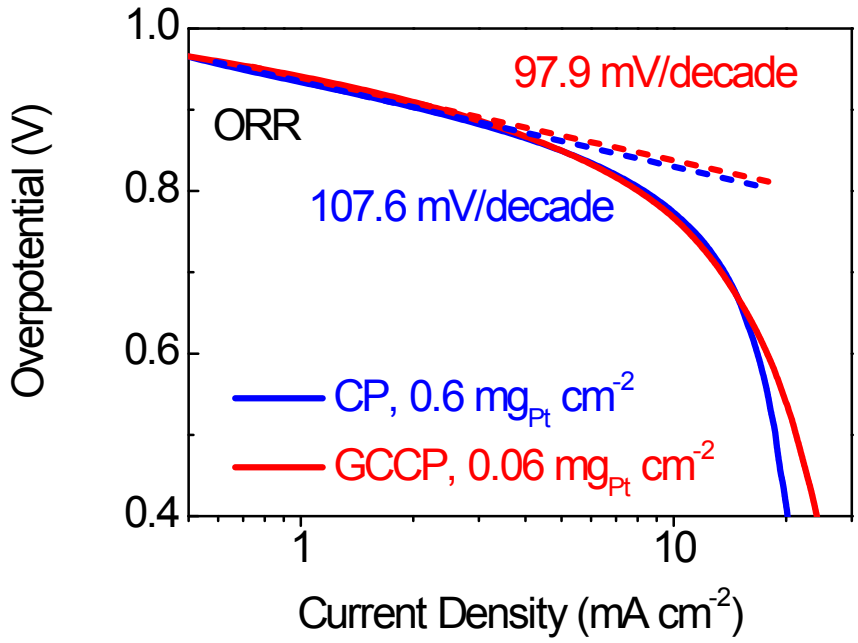


Fig. S18 Tafel slopes of GCCP-Pt and CP-Pt electrocatalysts for ORR.

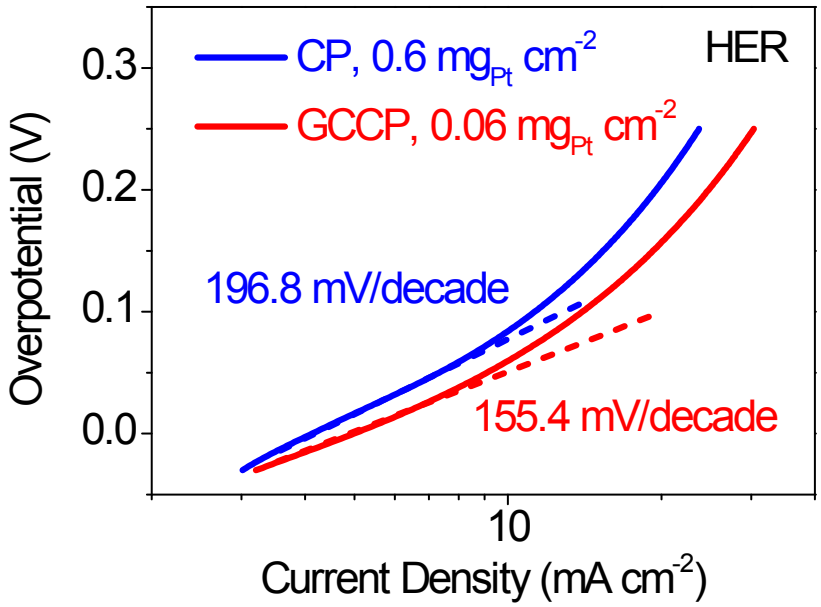


Fig. S19 Tafel slopes of GCCP-Pt and CP-Pt electrocatalysts for HER.

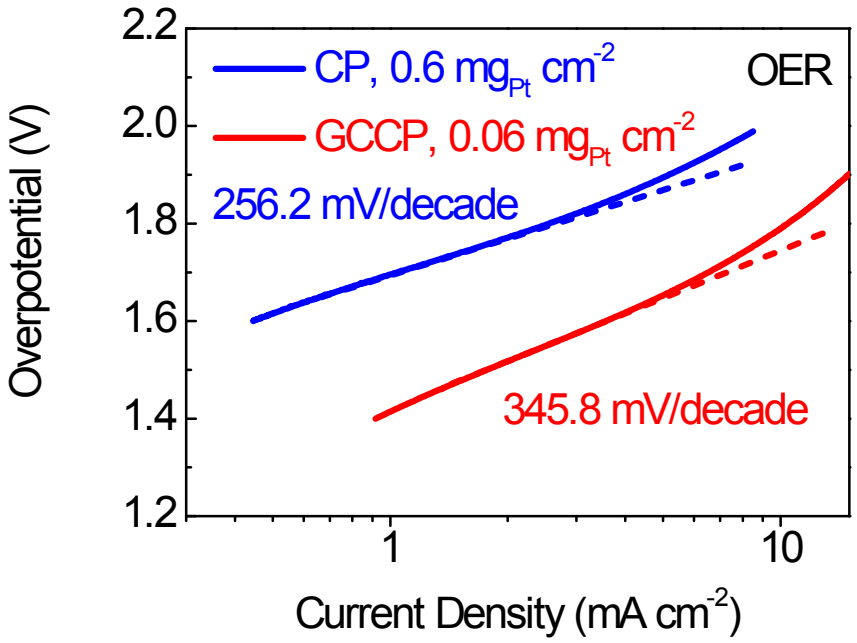


Fig. S20 Tafel slopes of GCCP-Pt and CP-Pt electrocatalysts for OER.

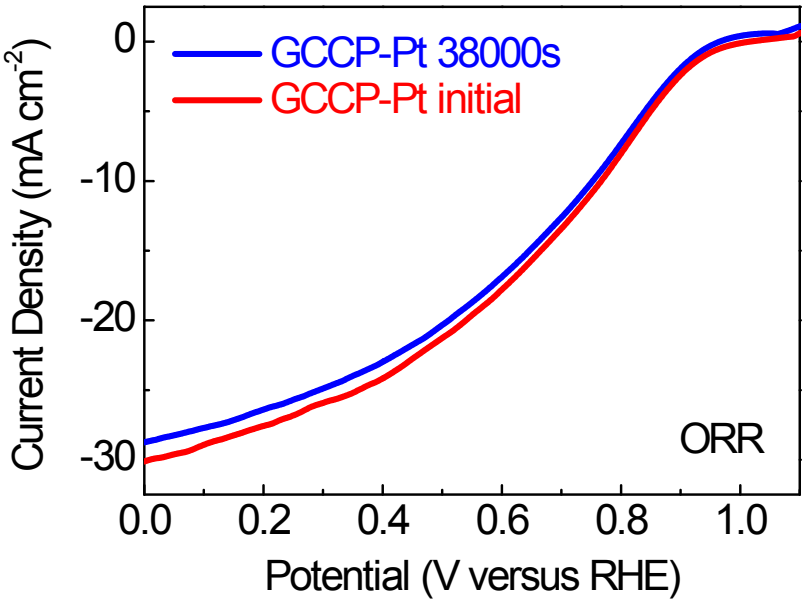


Fig. S21 Polarization curves of GCCP-Pt before and after 38,000s in O_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1}.

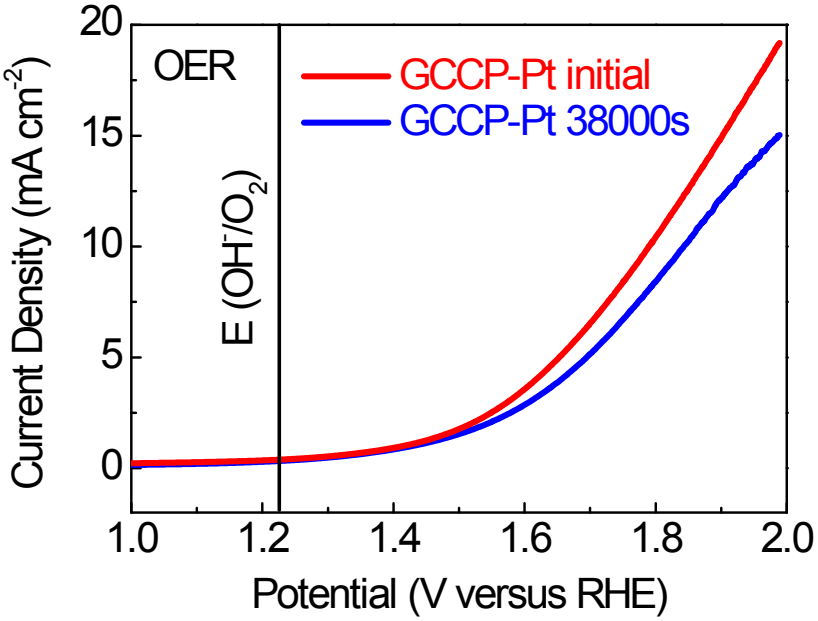


Fig. S22 Polarization curves of GCCP-Pt before and after 38,000s in N_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1}.

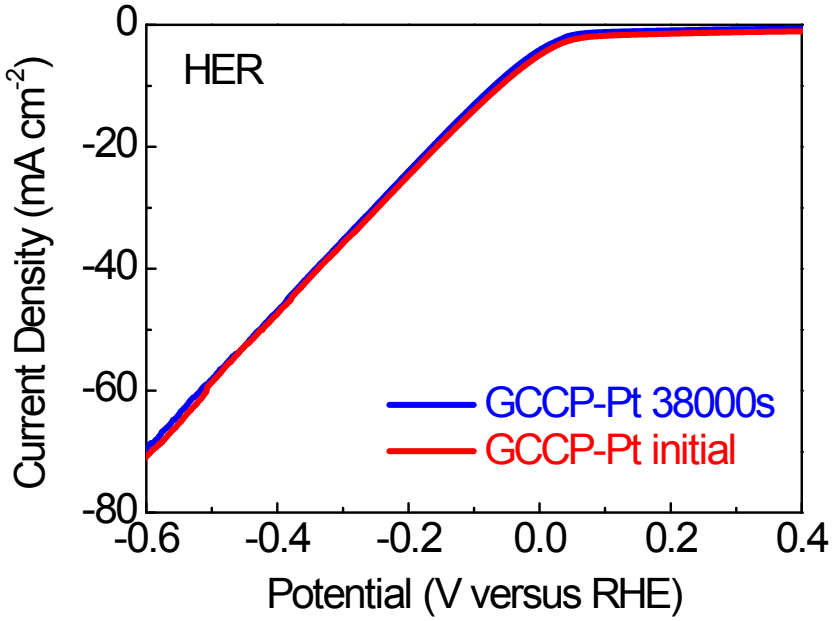


Fig. S23 Polarization curves of GCCP-Pt before and after 38,000s in N_2-saturated 0.1 mol L^{-1} KOH solution with a sweep rate of 5 mV s^{-1}.