Supplementary Information

A versatile graphene foil

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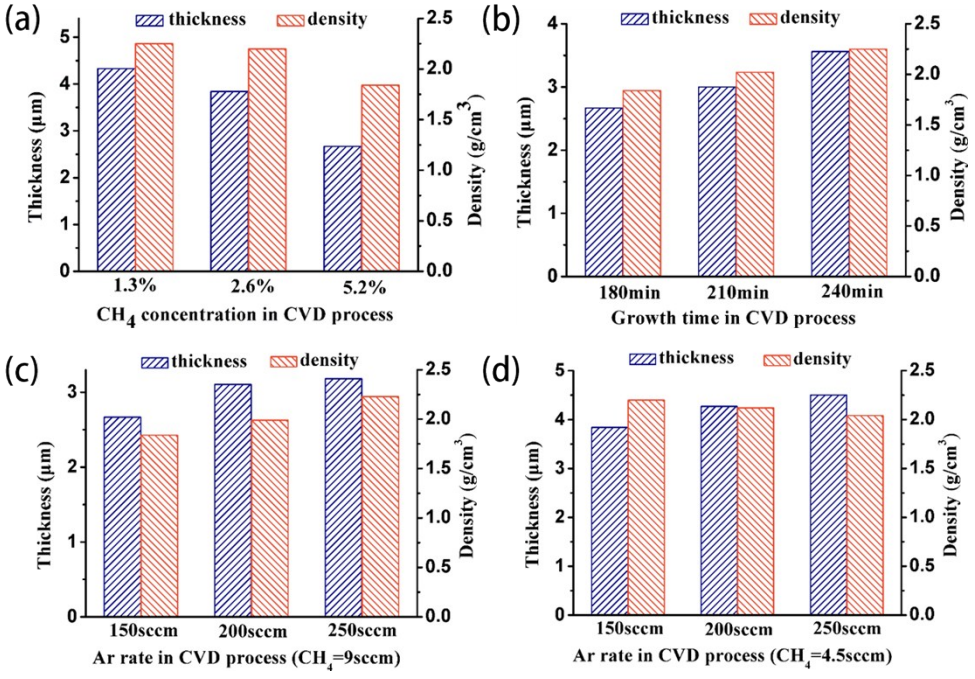

Fig. S1. The thickness and density of GF synthesized with different (a) CH_4 concentration. (b) Growth time. (c) Ar flow rate with CH_4 flow rate of 9 sccm. (d) Ar flow rate with CH_4 flow rate of 4.5 sccm.

The thickness (δ) and density (ρ) of the GFs obtained with CH_4 concentration of both 1.3 % (δ4.3 μm, ρ2.25 g·cm^{-3}) and 2.6 % (δ3.9 μm, ρ2.20 g·cm^{-3}) were higher than that of 5.2 % (δ2.7 μm,

ρ1.84 g·cm^{-3}) (Fig. S1a), that is to say, a thicker foil with high density could be generated under a low flow rate of CH_4 (the total amount of CH_4 was the same under different experimental conditions). In other words, Ni catalyst could be fully exposed to the carbon source at a low flow rate, ensuring a more adequate catalyzed reaction. The thickness and density of GF increased linearly with the growth time (Fig. S1b). Ar concentration could be used as another effective parameter to control the thickness and density of GF (Fig. S1c and S1d). The GF density increased with the Ar flow rate at a high CH_4 concentration. However, when low CH_4 concentration was introduced, a high Ar flow rate seemed to restrain the density of GF. In a word, the results were consistent with the comparison of the different CH_4 concentrations, a low growth rate could lead to a high density of GF.

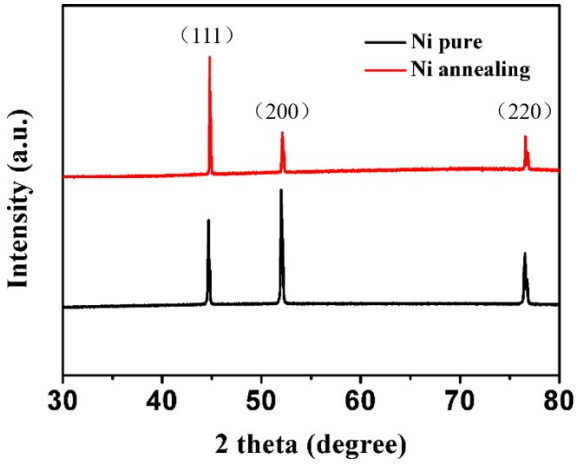

Fig. S2. XRD spectra of the Ni foil before and after annealing process.

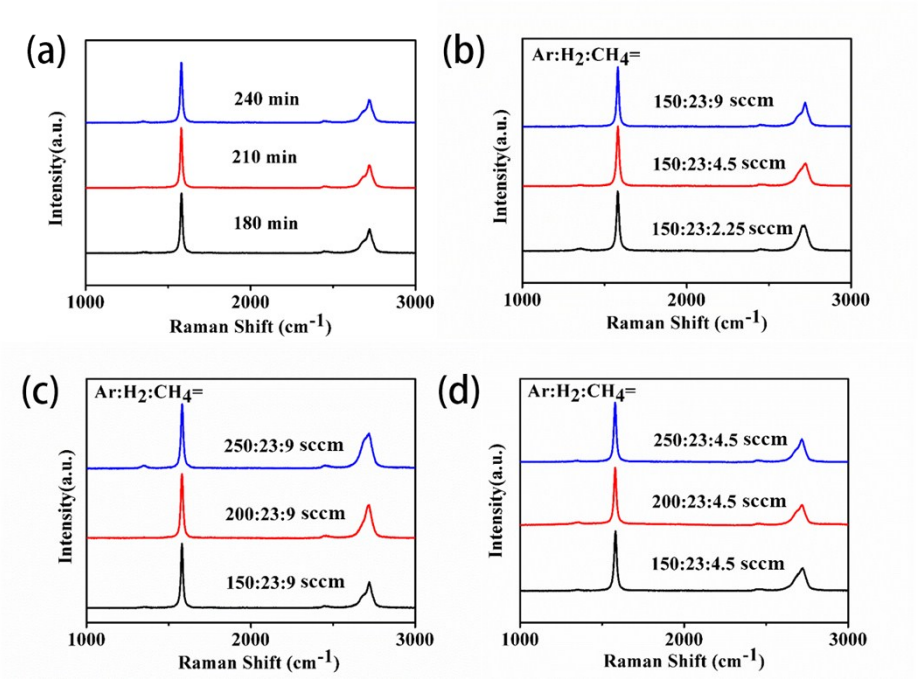

Fig. S3. Raman spectra of the GF synthesized with different (a) Growth time. (b) CH_4 concentration. (c) Ar flow rate with CH_4 flow rate of 9 sccm. (d) Ar flow rate with CH_4 flow rate of 4.5 sccm.

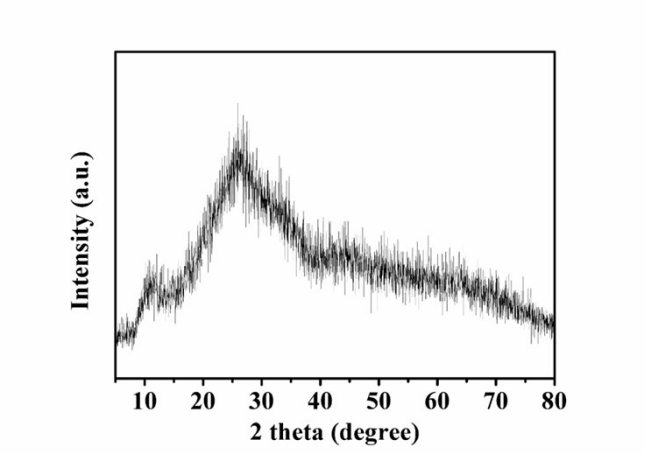

Fig. S4. XRD spectrum of graphene film reduced at 1050 °C.

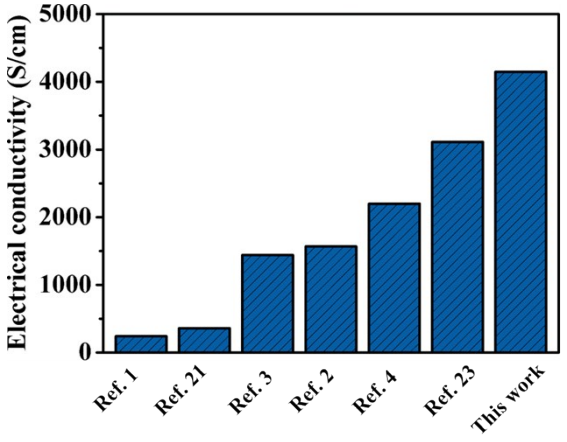

Fig. S5. Electrical conductivity of the GF and previous reports.

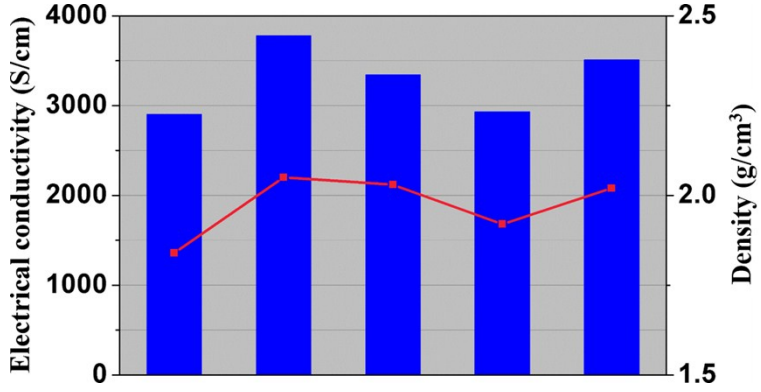

Fig. S6. Electrical conductivity and density of the GF synthesized with different **(**a) Gas flow rate: Ar:H_2:CH_4=150:23:9 sccm, heating rate: 17 ^oC/min, growth temperature: 1050 ^oC, annealing time: 30 min, growth time: 180 min, cooling rate: natural. (b) Heating rate: 10 ^oC/min to 1050 ^oC. (c) Cooling rate: 10 ^oC/min. (d) Annealing time: 60 min. (e) Growth temperature: 1000 ^oC. All the conditions are referred to (a).

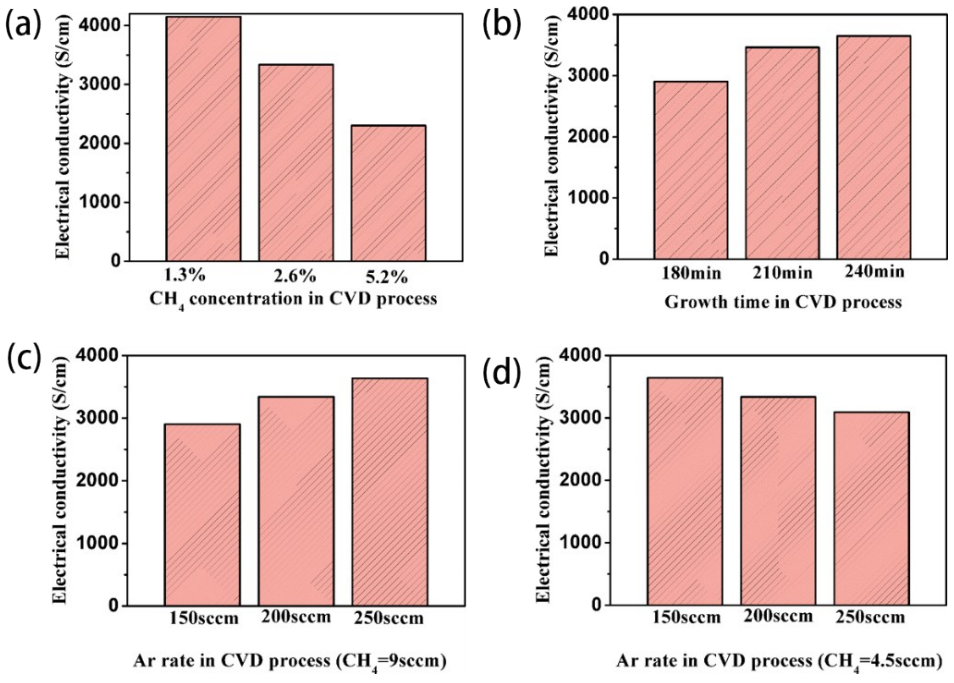

Fig. S7. Electrical conductivity of the GF synthesized with different (a) CH_4 concentration. (b) Growth time. (c) Ar flow rate with CH_4 flow rate of 9 sccm. (d) Ar flow rate with CH_4 flow rate of 4.5 sccm.

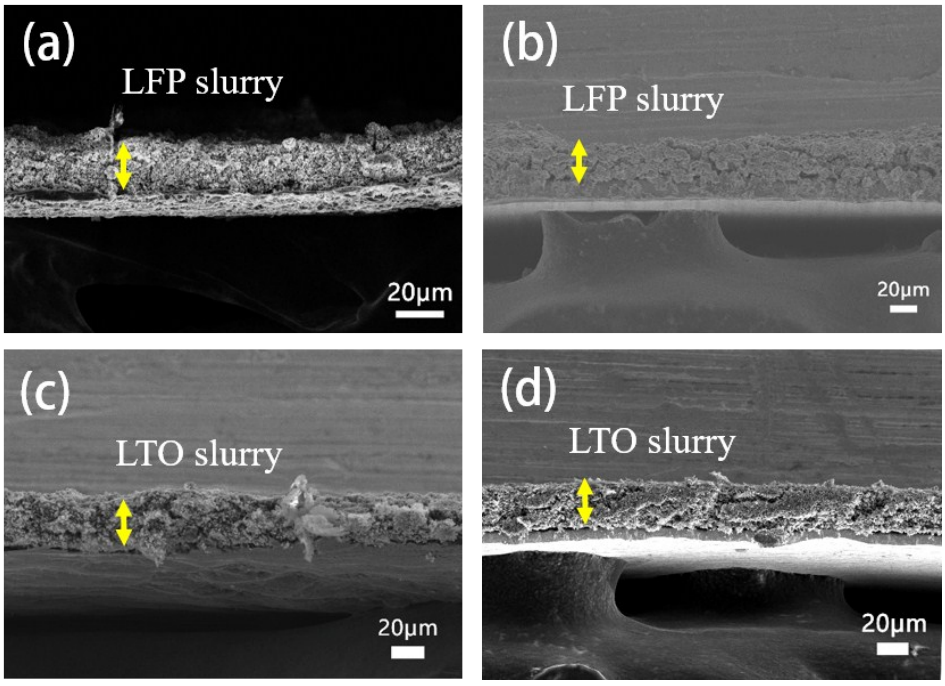

Fig. S8. SEM images of electrodes concluding current collectors and active materials. (a) GF with LFP. (b) Al with LFP. (c) GF with LTO. (d) Cu with LTO.

The microstructure of the GFs as well as the metallic current collectors with LFP and LTO as shown in Figure S8. We ensured that LFP cathodes using both GF and Al as the current collectors had the same thickness of ~20 μm. We also made sure that the LTO anodes using both GF and Cu as the current collectors had the same thickness of ~30 μm.

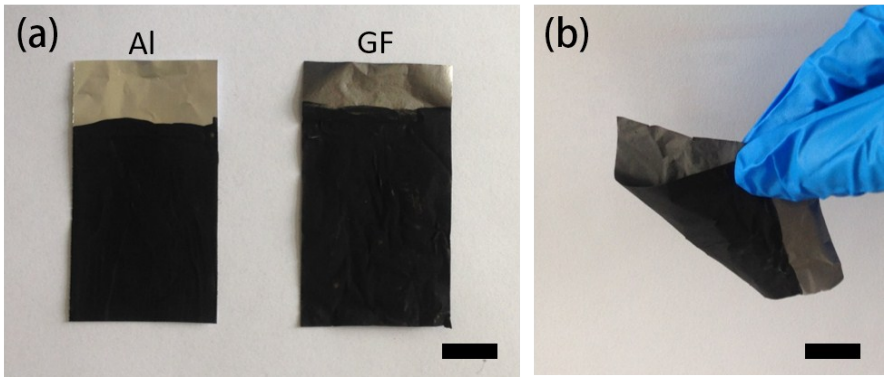

Fig. S9. a) Photograph of two kinds of current collectors with slurry of active materials. b) Photograph of GF electrode showing flexibility. Scale bar is 2 cm.

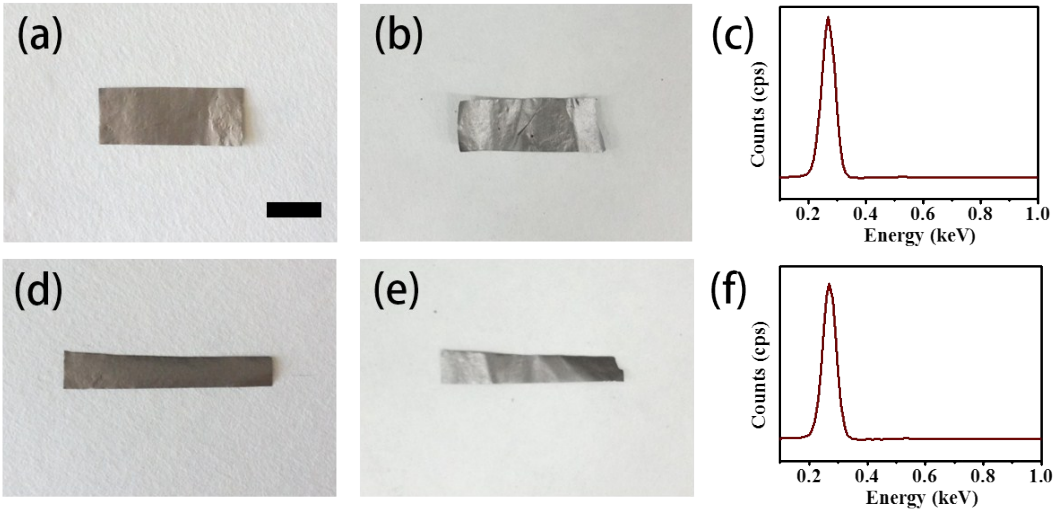

Fig. S10. Photographs of GF wetted in NMP. Scale bar is 2 cm. (a) Before wetting. (b) After wetting. (c) EDS spectrum of GF after wetting. And in electrolyte. (d) Before wetting. (e) After wetting. (f) EDS spectrum of GF after wetting.

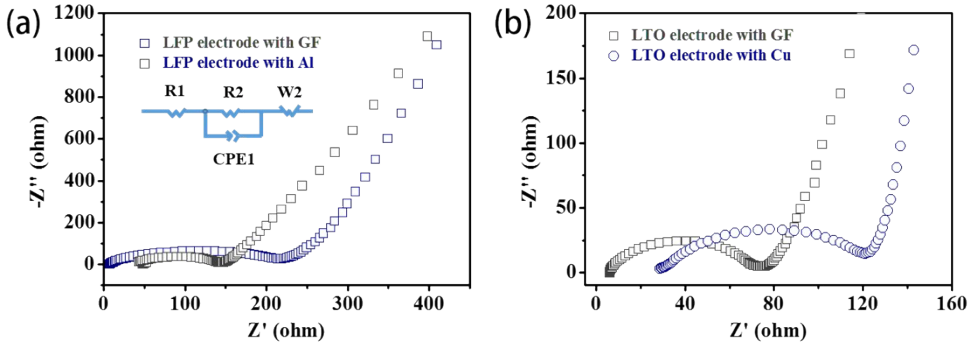

Fig. S11. Impedance spectra of half cells using the two kinds of current collectors (a) LFP cathode. (b) LTO anode.

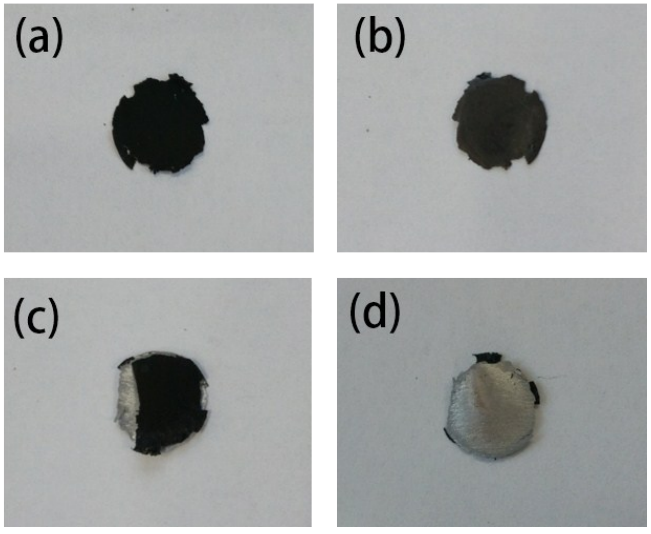

Fig. S12. Photographs of LFP electrodes after testing. (a,b) Front and back of the cathode with GF as current collector. (c,d) Front and back of the cathode with Al as current collector.