GeO_2/graphene nanofiber anode for low temperature Lithium- ion batteries

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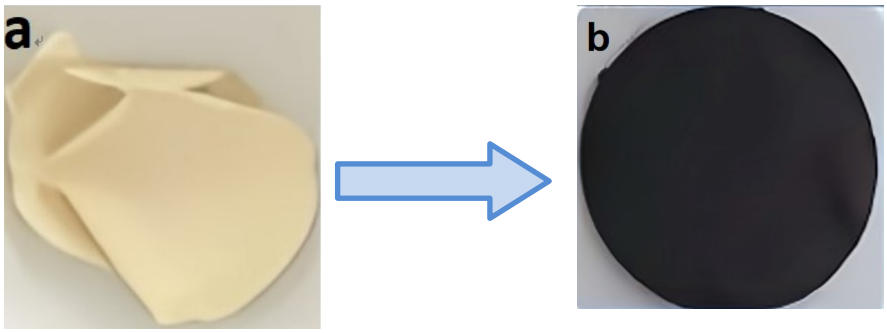

Fig. S1 The electrospinined GeO_2@G NF membrane after (a) vacuum dried and (b) annealed and cutted.

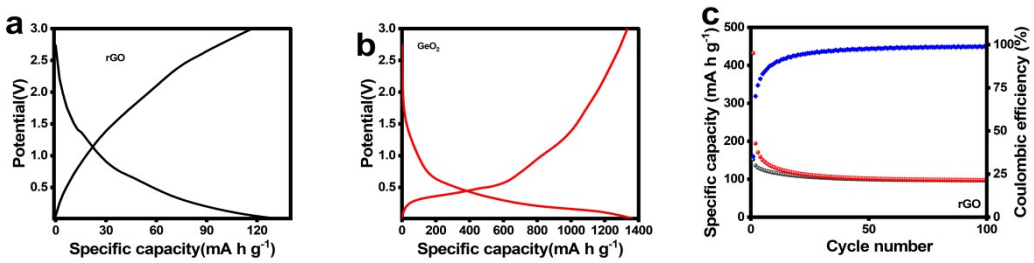

Fig. S2 The charge/discharge curves of (a) rGO and (b) amorphous GeO_2, (c) cycling stability of rGO at 0.2 C.

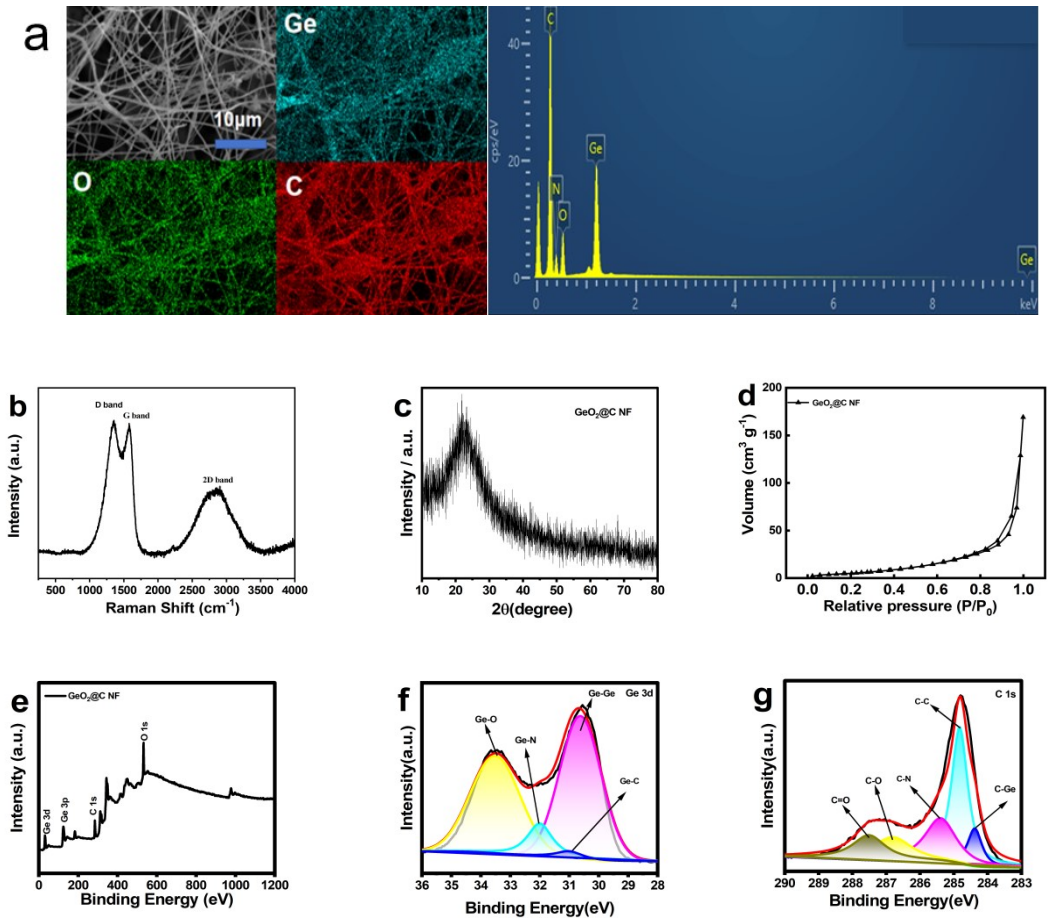

Fig.S3 The characterizations of GeO_2@C NF (a) EDS Mapping analysis, (b) Raman spectra, (c) XRD patterns, (d) BET, and (e-g) XPS spectra.

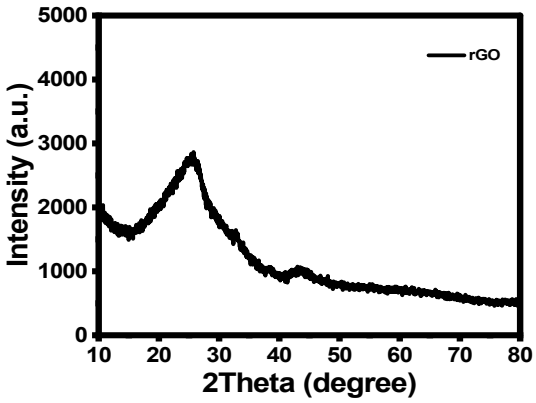

Figure S4. XRD pattern of rGO.

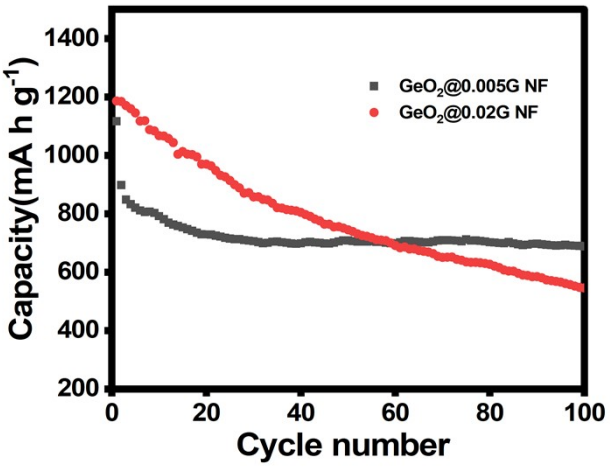

Figure S 5. Cycling stability of GeO_2@0.005G and GeO_2@0.02G NF at 0.2 C.

Two control samples were prepared. For the first sample, the amount of GO was reduced by half (0.005 g) while the other components were kept unchanged, and the sample is abbreviated as GeO_2@0.005G NF. When subjected to a cycling test at a current density of 0.2 C, GeO_2@0.005G NF showed slightly higher initial capacity but poorer cycling performance compared to GeO_2@C NF. For the second sample, the amount of GO was doubled (0.02 g) while the other components were kept unchanged, and the sample is abbreviated as GeO_2@0.02G NF. When subjected to a cycling test at a current density of 0.2 C, GeO_2@0.02G NF also showed slightly higher initial capacity but poorer cycling performance compared to GeO_2@C NF. Because if the proportion of graphene is too low, lacking high-toughness graphene support, the 1D structure of the sample fractures easily during Li^+ insertion/extraction, but overly high proportion of graphene in the sample made it difficult to form the 1D structure. Therefore, two samples failed to mitigate the volume expansion of GeO_2 during the charge-discharge process, resulting in decreased cycling stability.