

Supplementary Information

Novel Hybrid Carbon Nanofiber/highly Branched Graphene Nanosheet for Anode Materials in Lithium-ion Batteries

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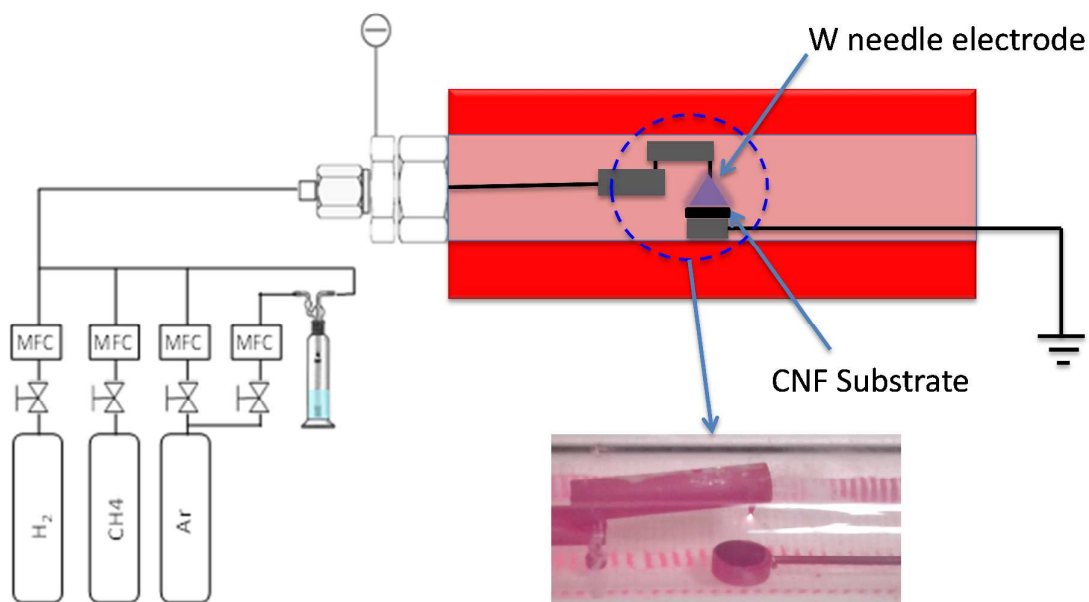


Figure S1. Experimental setup for CNF/HBGN growth using PECVD at atmospheric pressure. The bottom photo in the figure shows a tungsten needle electrode pointing in the direction of the CNF substrate sitting on a disc electrode, generating a glow discharge between the electrodes.

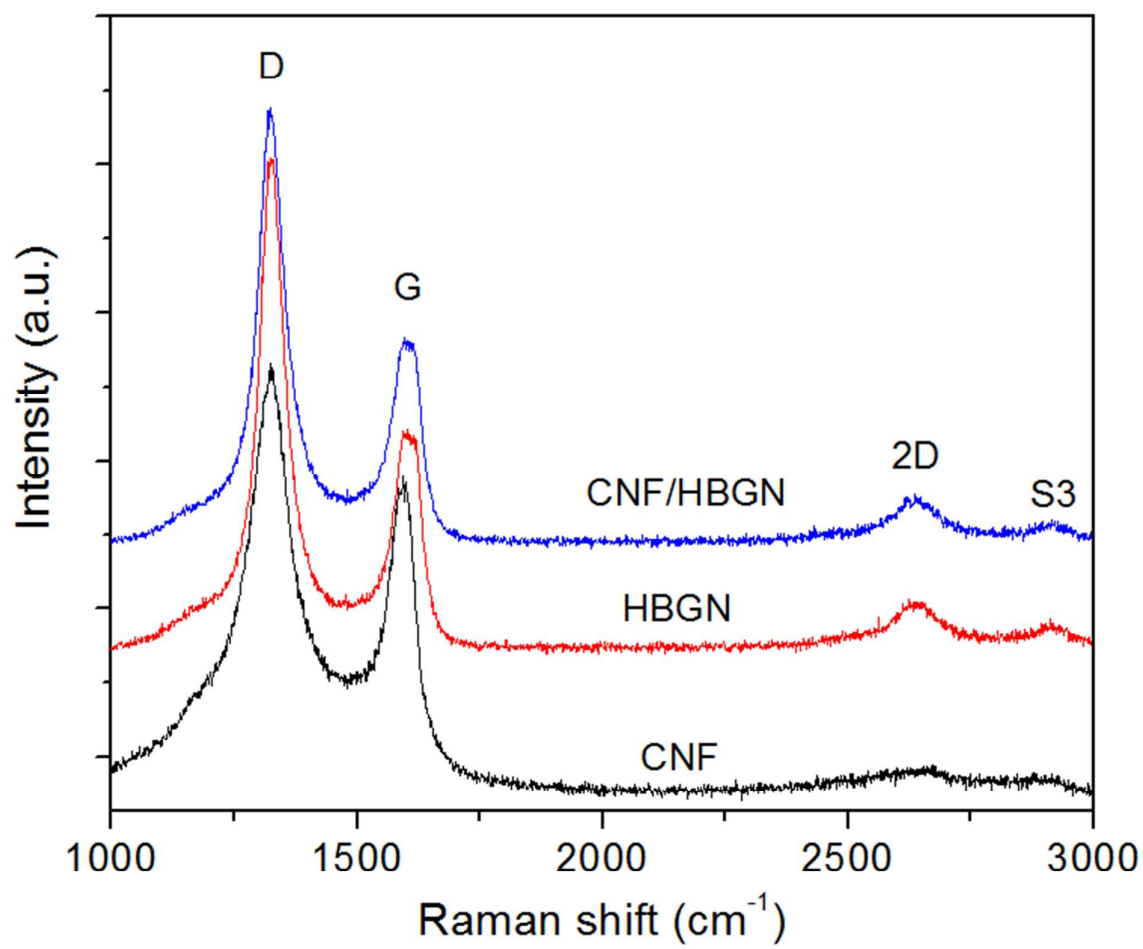


Figure S2. Raman spectra of CNF, HBGN and CNF/HBGN.

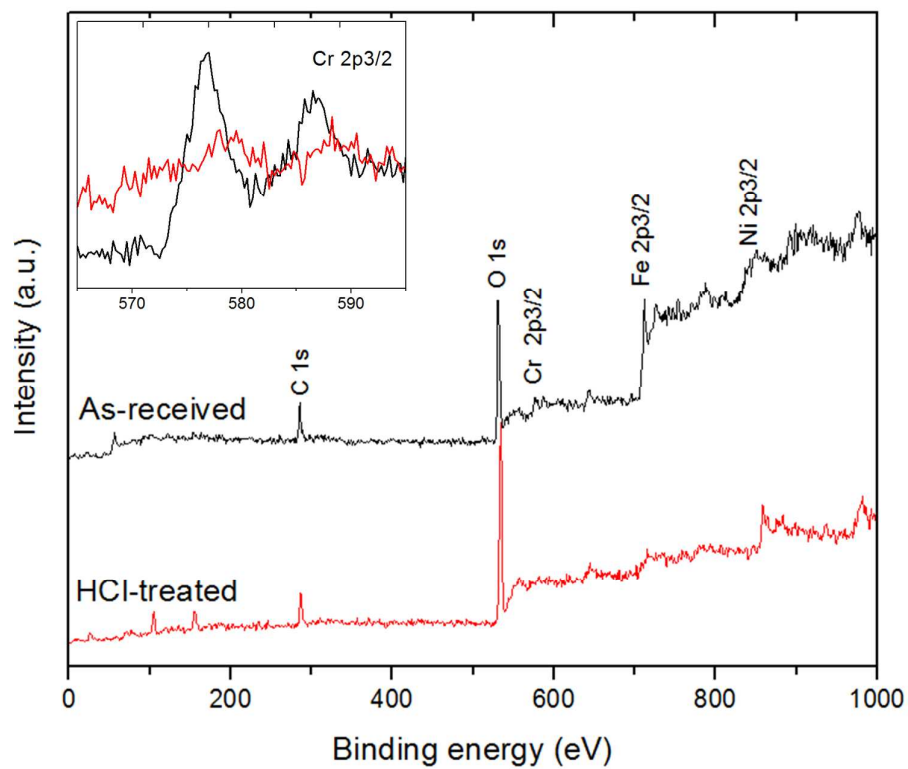


Figure S3. XPS analysis of stainless steel before and after HCl treatment for 10 min.



Figure S4. CNF covered on the acid treated (left half) and no CNF observed on the untreated (right half) stainless steel foil.

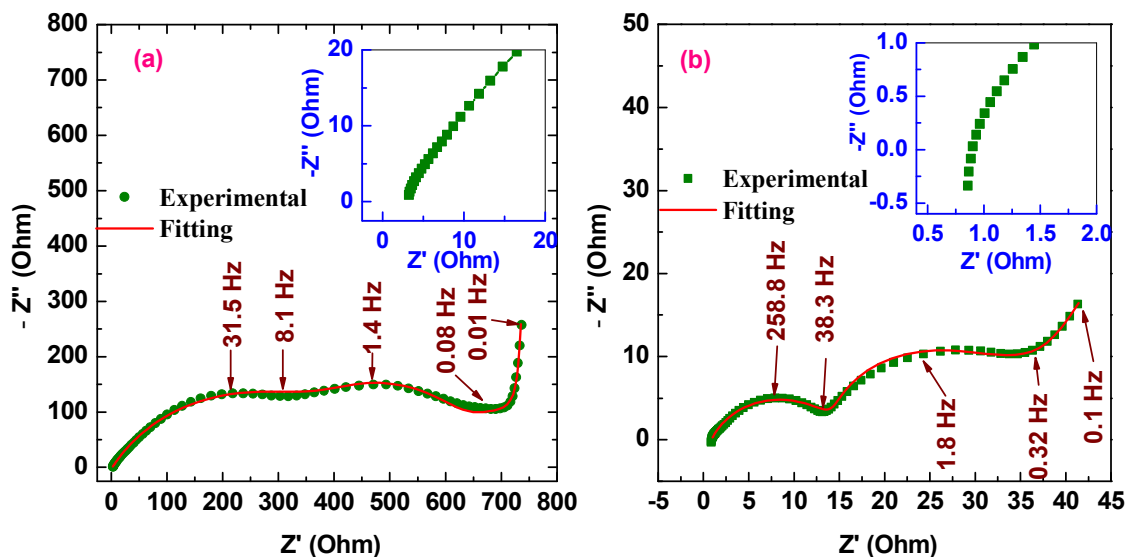


Figure S5. Nyquist plots of the CNF (a) and CNF/HBGN hybrid (b) anodes at the half charged states. Note that the three points at highest frequencies for the CNF/HBGN hybrid anode were deleted during the fitting process because their imaginary parts of the impedances are positive (i.e., $-Z'' < 0$ Ohm), which is unable to be fitted by the Zview software. Without the deletion of these points, the fitting error will increase significantly. The frequency range was set as 10,000-0.1 Hz for the CNF/HBGN hybrid anode, as compared to 10,000-0.01 Hz for the CNF anode. The lower frequency limit has to be reduced to 0.01 Hz for the CNF anode; otherwise, it is unable to have the EIS data for the Li ion diffusion. In general, it takes long time to acquire the data at very low frequencies, which may increase the inaccuracy of the result. As a matter of fact, potential changes of electrodes can be observed after EIS tests when the lower frequency is reduced to 0.01 Hz or even lower.

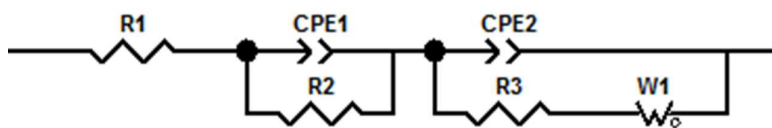


Figure S6. Equivalent circuit with two time-constants.

