

Supporting Information

Ultralight porous carbon scaffold for anode-free lithium metal batteries

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Growth Mechanism

C-grapes are grown on a surface using methane (CH_4) gas as a carbon source. The growth process is monitored at different stages by varying the duration of CH_4 exposure. In the first step, after 15 minutes of CH_4 flow, carbon atoms form a micron-sized thin carbon film on the surface (as shown in Fig. S1a). In the second step, after 25 minutes of CH_4 exposure, these carbon clusters begin to agglomerate, leading to the nucleation of C-grapes (Fig. S1b). In the third step, after 30 minutes of CH_4 exposure, the carbon clusters further develop into vertically hanging nano-sized grapes (Fig. S1c). The diameter of the C-grapes is influenced by both the temperature and the duration of CH_4 exposure. Despite these variations, the growth conditions are kept consistent to produce similar materials suitable for use as anodes in anode-free batteries (Fig. S1d).

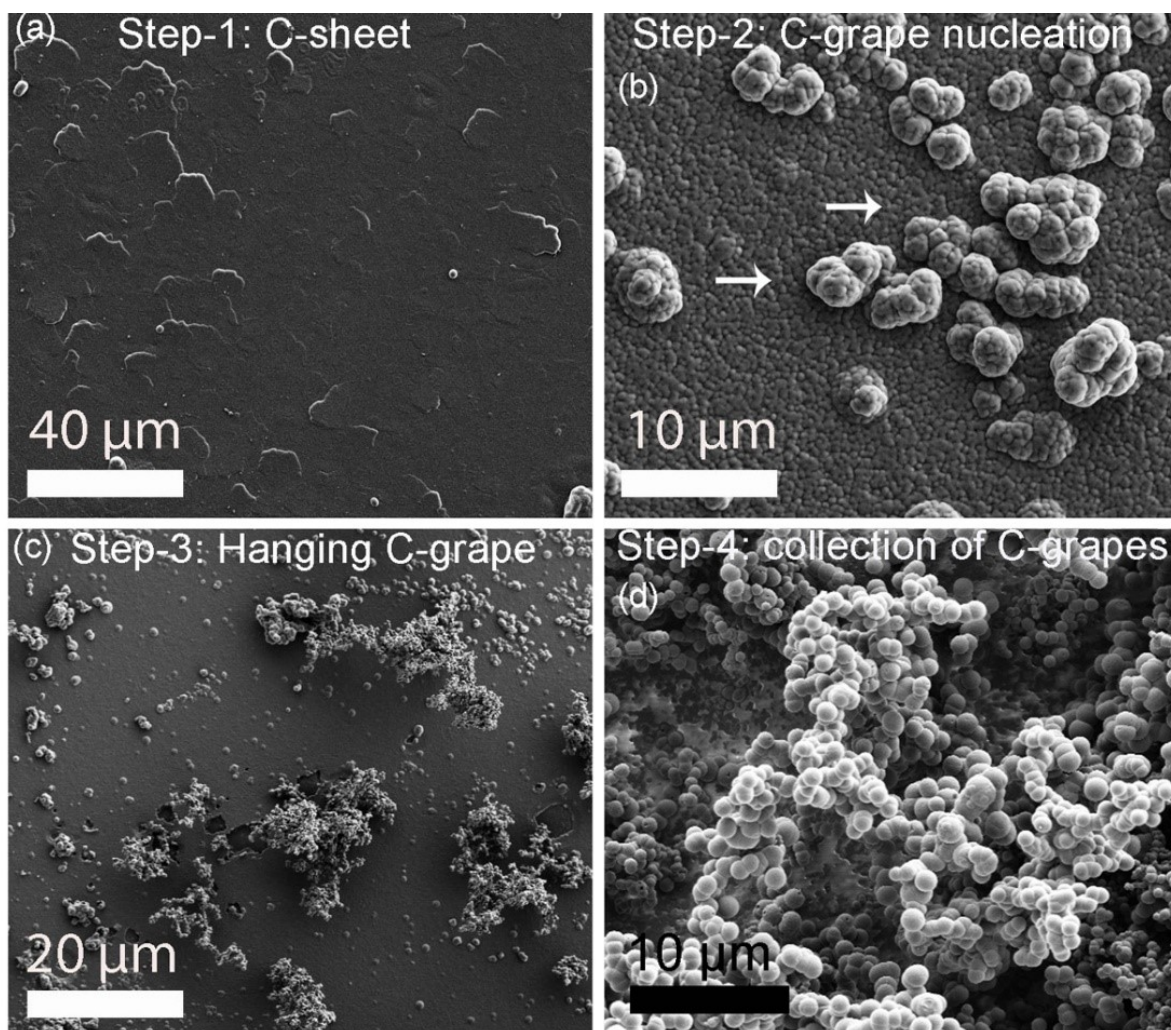


Figure S1. SEM image of the growth mechanism of C-grapes in CVD (a) C-thin film formation (b) nucleation of C-grapes started (c) hanging grapes can be seen (d) collected C-grapes in gram scale.

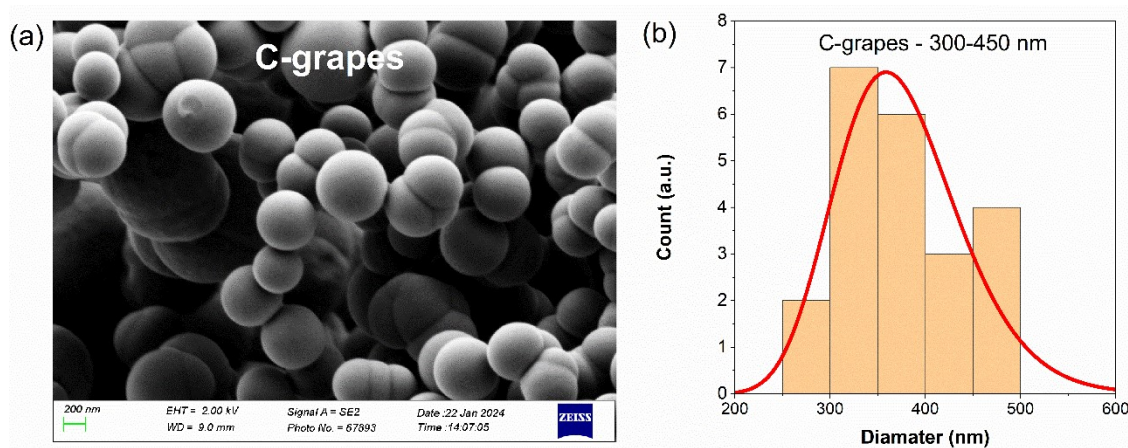


Figure S2. SEM of the C-grapes (a) and corresponding diameter distribution of C-grapes (b).

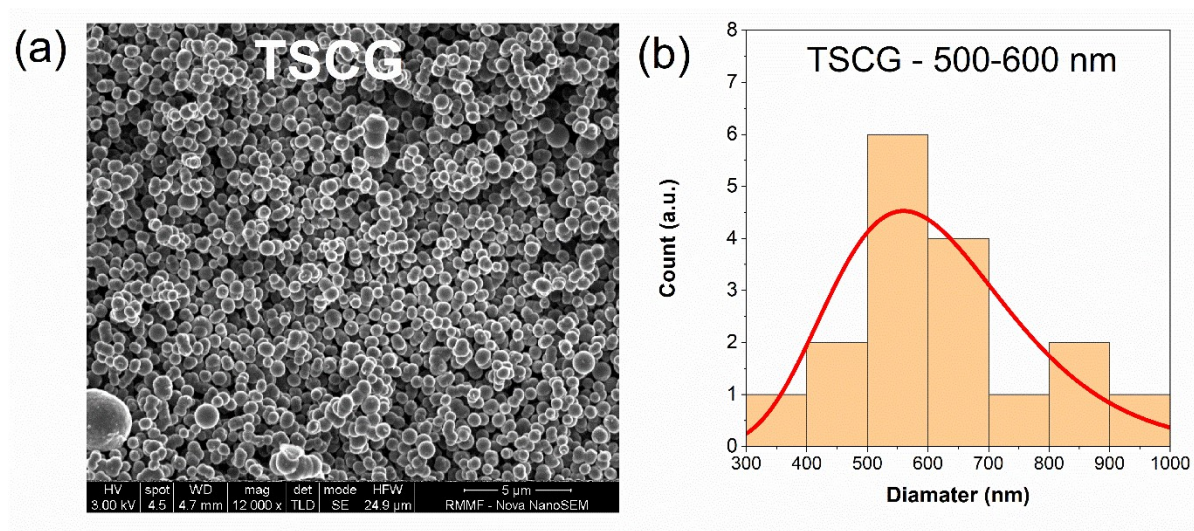


Figure S3. SEM of the TSCG (a) and corresponding diameter distribution of TSCG (b).

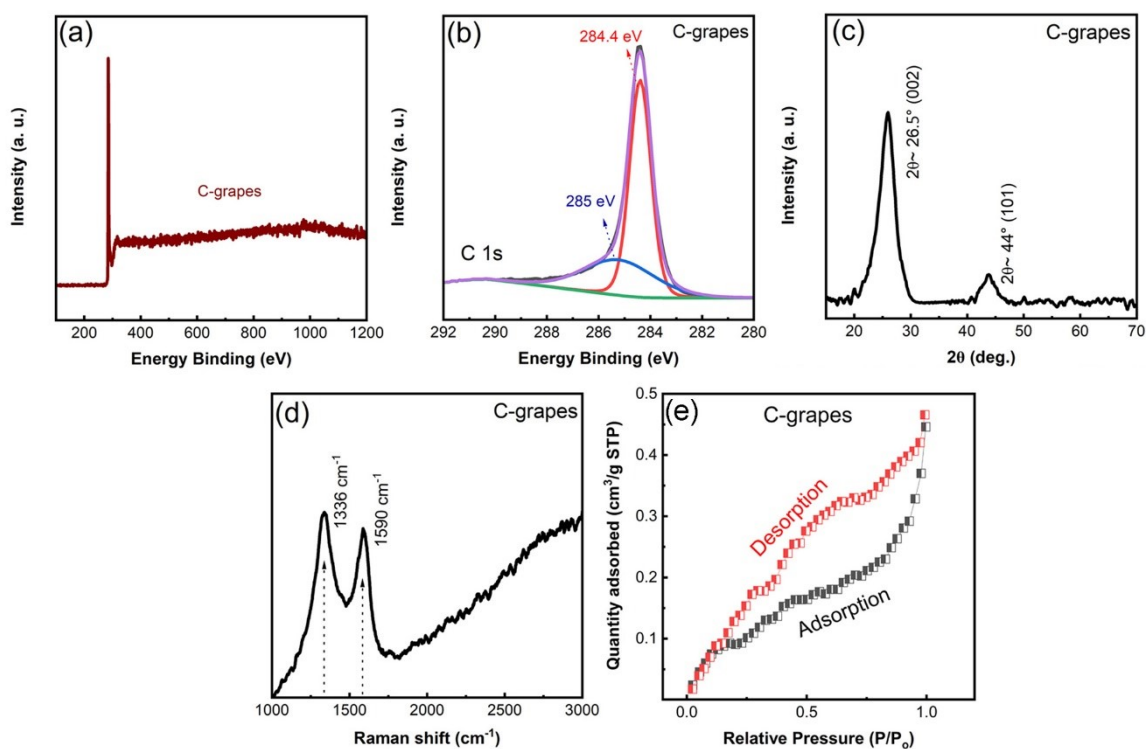


Figure S4. XPS survey conducted under a range of binding energy ~ 100 - 1200 eV (a) and C 1s spectra fitted with sp^3 and sp^2 hybridized carbon in C-grapes (b). XRD (c) and Raman (d) of C-grapes conducted at $2\theta = 10$ - 70° and 636 nm wavelength of laser light, respectively. The adsorption/desorption hysteresis of C-grapes indicates its porosity (e).

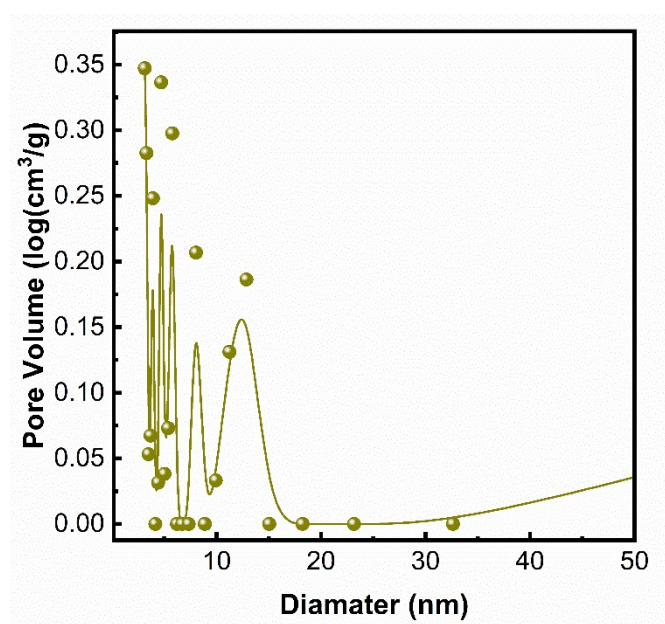


Figure S5. Pore volume vs. pore diameter of C-grapes curve

Full cell battery works fine to light LED as shown in Figure S6a-b, indicating formation of successful full cell battery.

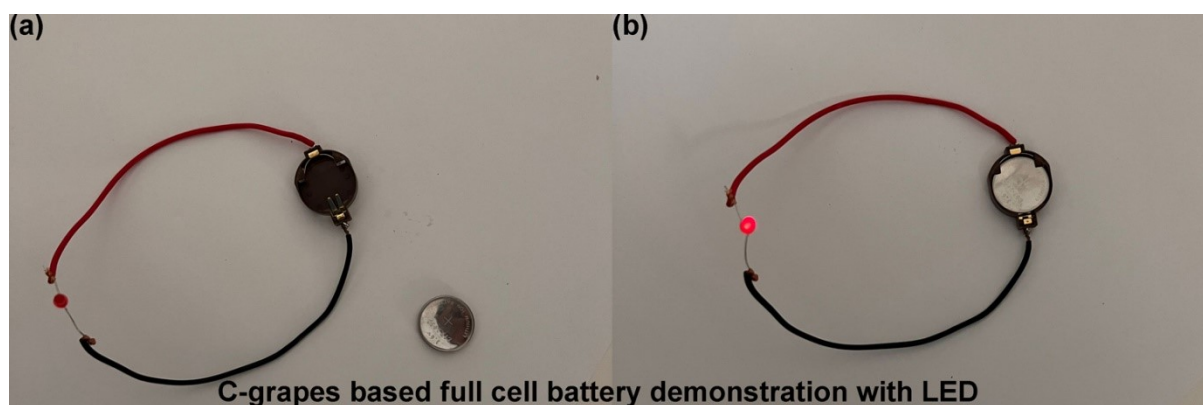


Figure S6. Schematic of full cell battery working without (a) and with LED (b).