Sustainable Lithium-Ion Batteries: Constructing Biochar-Based Conductive Networks for LMFP Cathodes

I-Hung Hsu[1], Che-Ya Wu[2], Wen-Lin Wang[3], Tzu-Ying Lin*

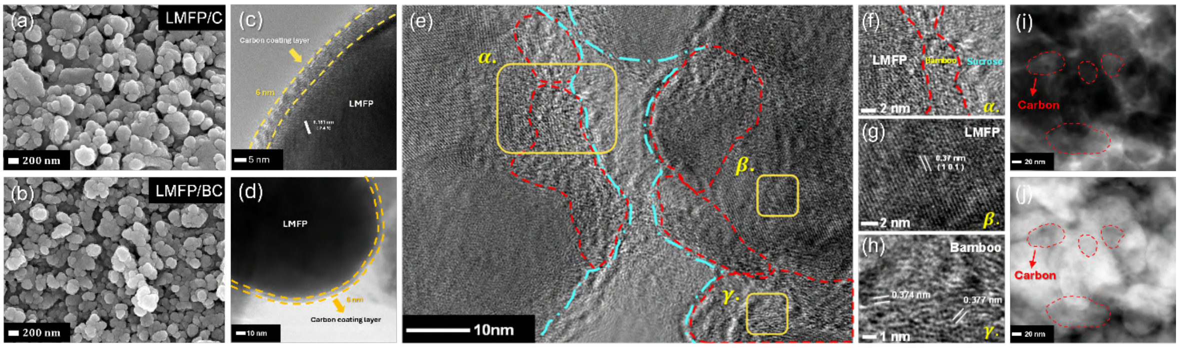

Figure. 1

Figure. 1a and 1b show that both samples exhibit irregular morphology with particle distribution ranging from 250 to 400 nm SEM morphology. As disclosed in the HR-TEM image shown in Figure. 1c and 1d reveal a 6 nm, smooth and uniform carbon layer on LMFP/C particle. Nevertheless, the carbon layer is mainly distributed in the external boundary region, which would substantially increase the Li^+ diffusion distance and reduce the number of active sites. In comparison, based on Figure. 1e and 1g, LMFP nanoparticles have an interplanar spacing of 0.37 nm, corresponding to (101) lattice plane are surrounded by bamboo biochar particles, which contain short-range and multi-directional arrangements with d-spacing ranging from 0.37 to 0.38 nm (Figure. 1h). Sucrose-derived carbon with more amorphous patterns serves as the glue to connect bamboo biochar and LMFP particles (Figure. 1f). The dark and bright field images of LMFP/BC (Figure. 1i and 1j) also prove the HRTEM results, which the hard carbon is not only distributed in the external surface but also exhibited throughout the interior of LMFP nanoparticles to form the carbon network through the cathode materials.

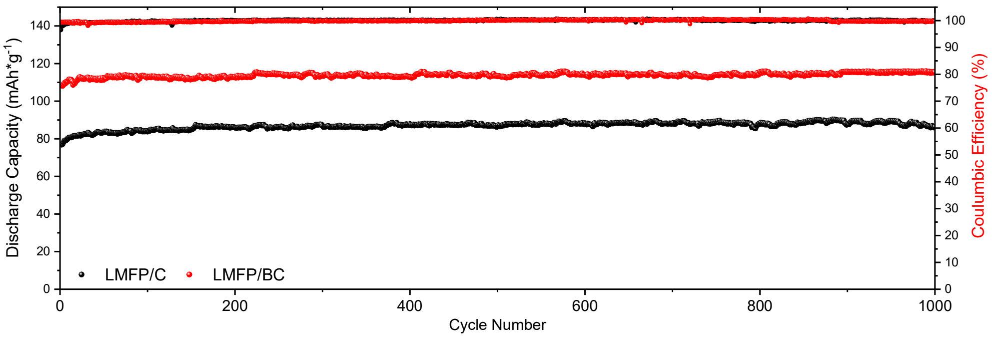

Figure. 2 Cycling performances of both LMFP samples at 1 C-rate at 25 °C between 2.4 and 4.5 V.

From Figure.2, The LMFP/BC in Li half-cell delivers the more outstanding specific capacity of 115 mAh/g and extraordinary capacity retention, which is achieved almost 100 % of initial capacity after 100 cycles, whereas LMFP/C exhibits lower capacity of 83 mAh/g.