
# Supporting Information

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# Air-Stable Copper-Based P2-$Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$ as a New Positive Electrode Material for Sodium-Ion Batteries

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**Author contributions**

Y.-S.H. conceived and designed this work; Y.M.L. performed all the synthesis and electrochemical experiments; L.G. and Z.Z.Y. performed STEM and EELS experiments; Y.M.L. and Y.-S.H. wrote the paper; all the authors participated in analysis of the experimental data and discussions of the results as well as preparing the paper.

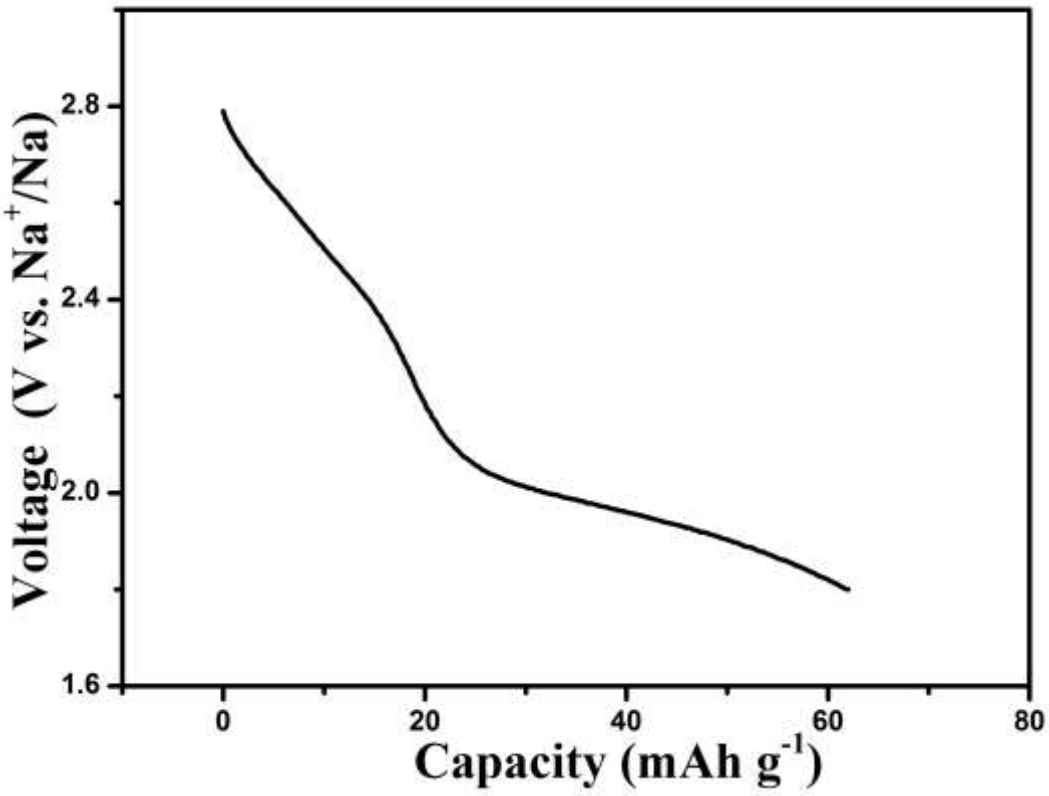


**Figure S1.** Discharge curve for the first cycle of the P2-$Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$ electrode under the condition of discharging first.

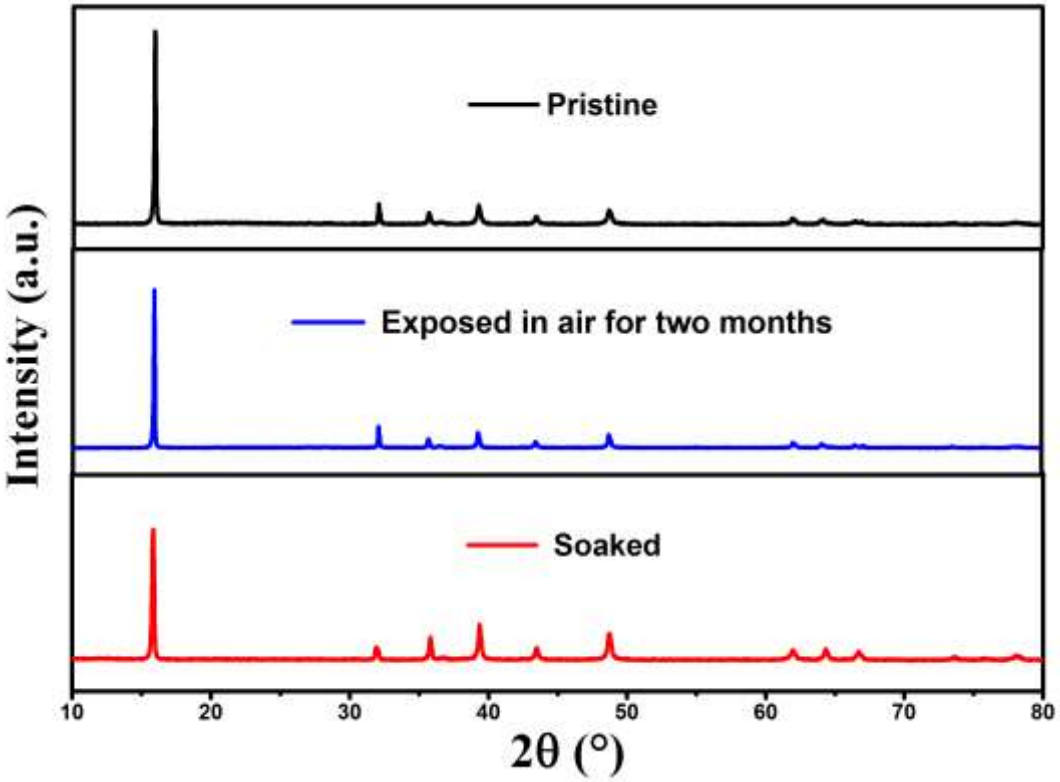


**Figure S2.** XRD patterns of the pristine P2-$Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$ sample, exposed in air for two months and after soaking into water.

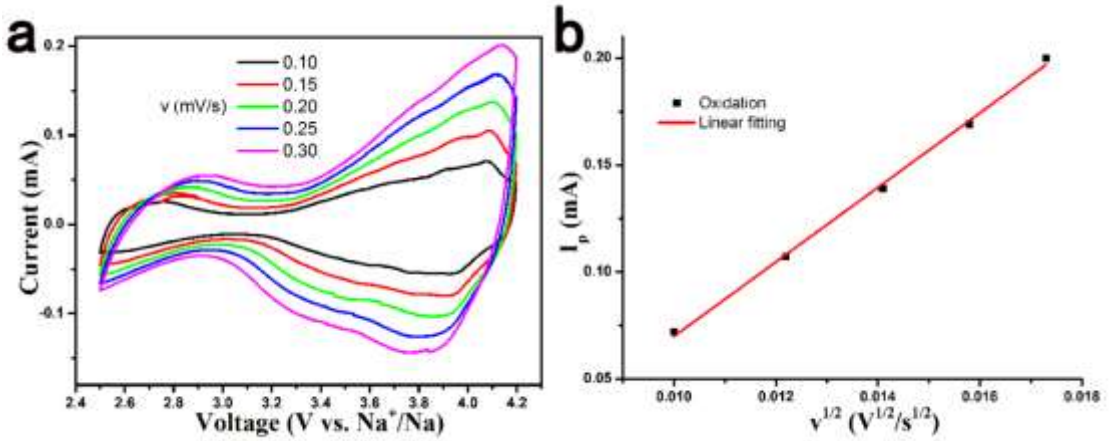


**Figure S3.** $Na^+$ ion diffusion kinetics in P2-$Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$. (a) Cyclic voltammograms of the P2-$Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$ electrodes at various scan rates, and (b) Relationship between peak current $I_p$ and square root of scan rate $v^{1/2}$. The $Na^+$ ion diffusion coefficient was calculated to be ~$2.7\times10^{-11}$ $cm^2$ $s^{-1}$. (Note that The $Na^+$ ion apparent diffusion coefficient was calculated according to the Randles-Sevcik equation:

$$I_p = 0.4463nFAC(nFDv/RT)^{1/2}$$

$I_p$ is peak current, n is the number of moles of electrons transferred in the reaction, F is Faraday constant, A is the area of the electrode, C is the extracted $Na^+$ ion concentration (in $mol/cm^3$) in $Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$, D is the apparent diffusion coefficient, and *v* is the scan rate.)

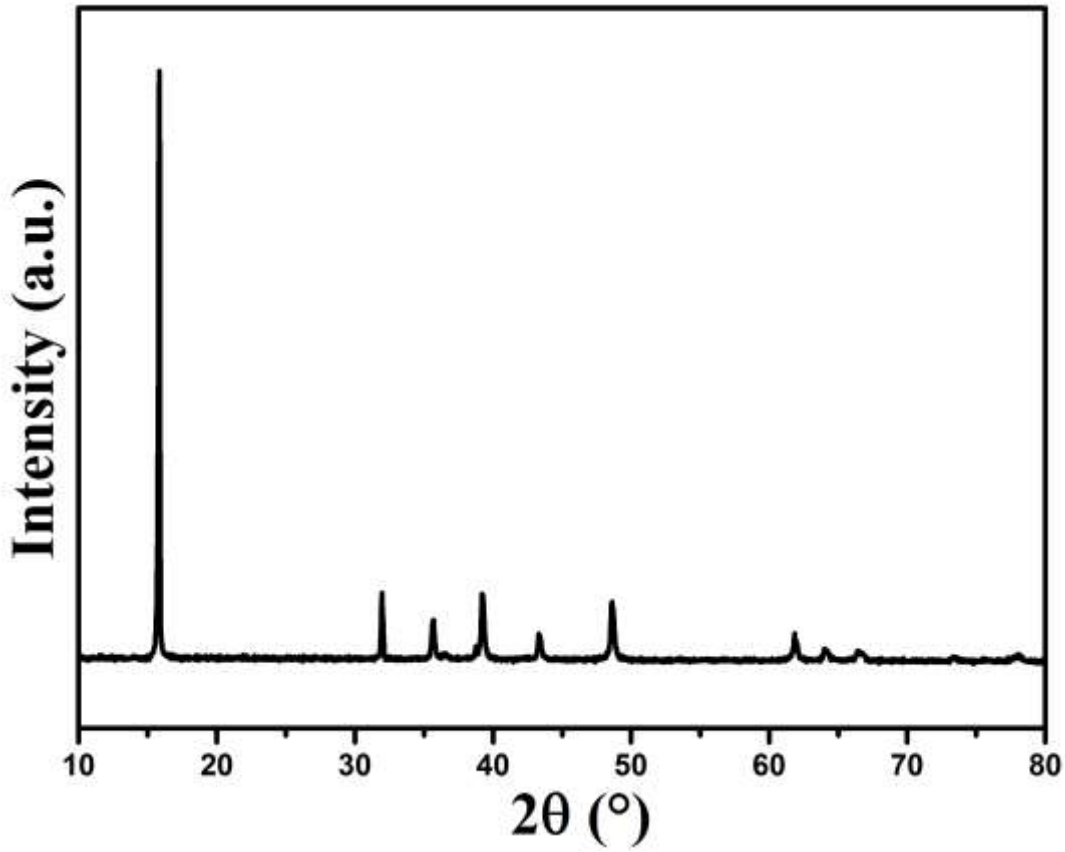


**Figure S4.** XRD pattern of the P2-$Na_{2/3}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$ sample.

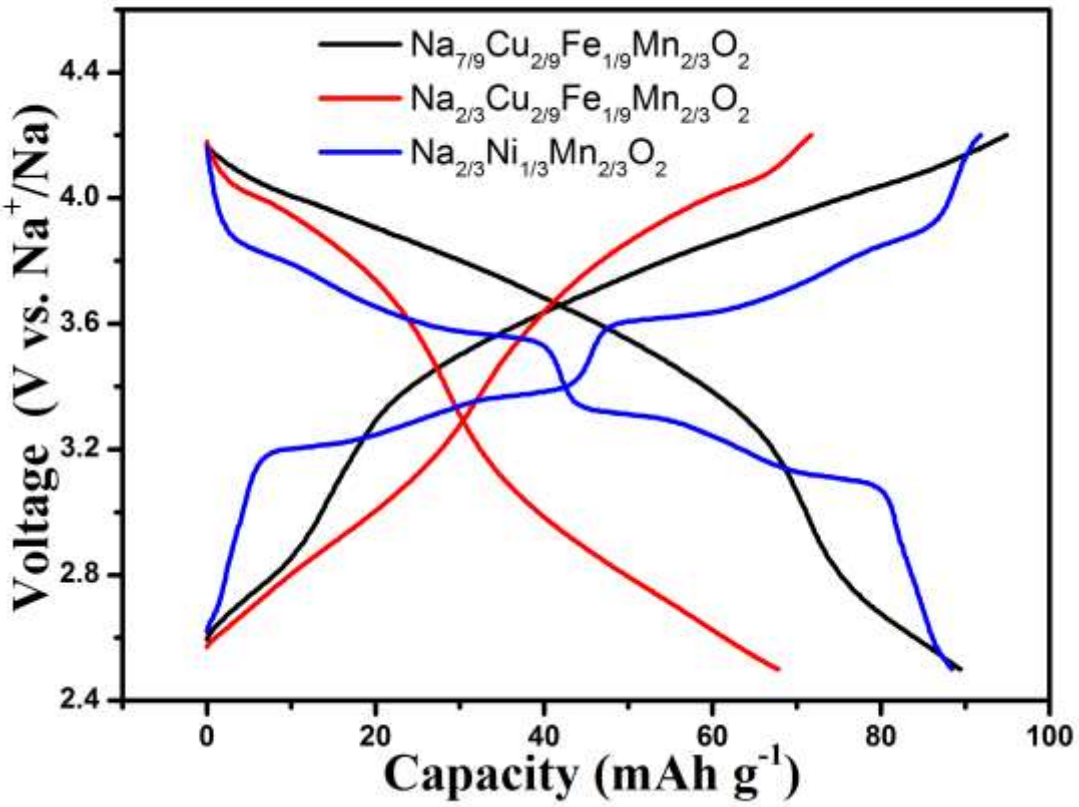


**Figure S5.** Charge-discharge curves for the second cycle of $Na_{7/9}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$, $Na_{2/3}Cu_{2/9}Fe_{1/9}Mn_{2/3}O_2$ and $Na_{2/3}Ni_{1/3}Mn_{2/3}O_2$.

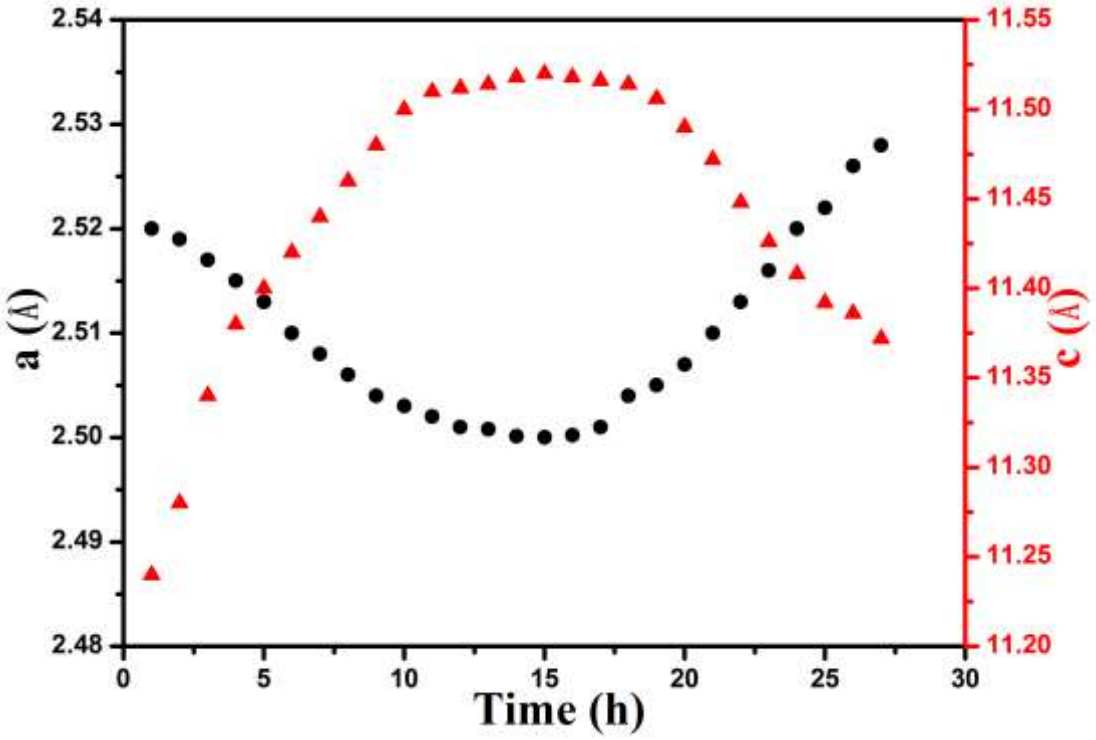


**Figure S6.** The evolution of the *a* and *c* lattice parameters during the first charge/discharge process.

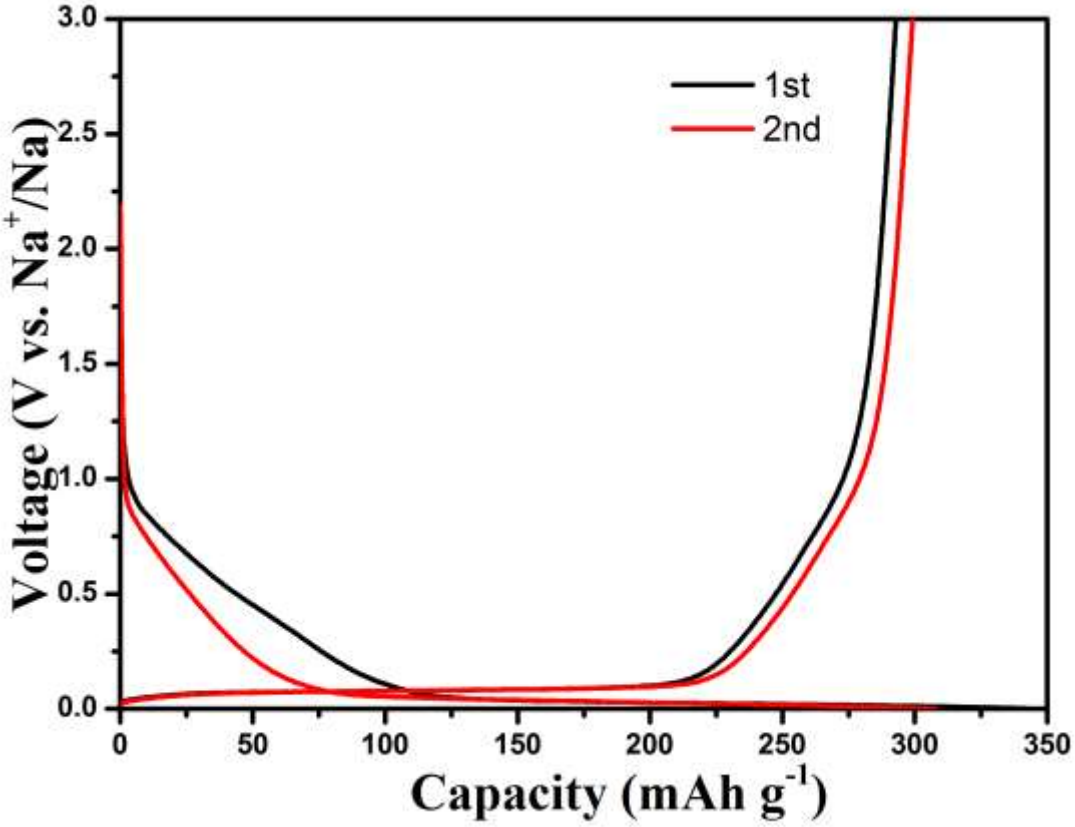


**Figure S7.** Charge-discharge curves for the 1st, 2nd cycles of the hard carbon negative electrode at 0.1C rate in the 0.8 M $NaPF_6$ - PC electrolyte.

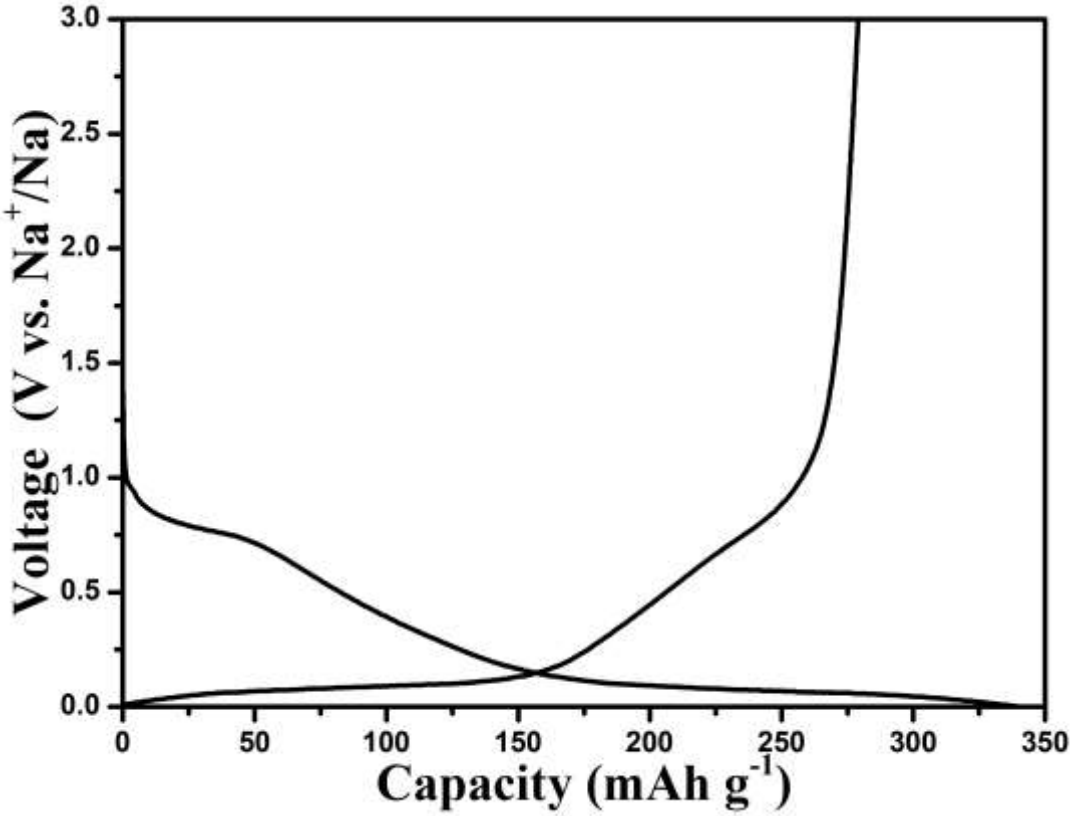


**Figure S8.** Charge-discharge curves for the 1st cycle of the hard carbon negative electrode at 0.1C rate in the 1 M $NaClO_4$ - EC:DEC (1:1) electrolyte.