

## Supplementary of the manuscript:

### Effect of vinylene carbonate on SEI formation on $\text{LiMn}_2\text{O}_4$ in carbonate-based electrolytes

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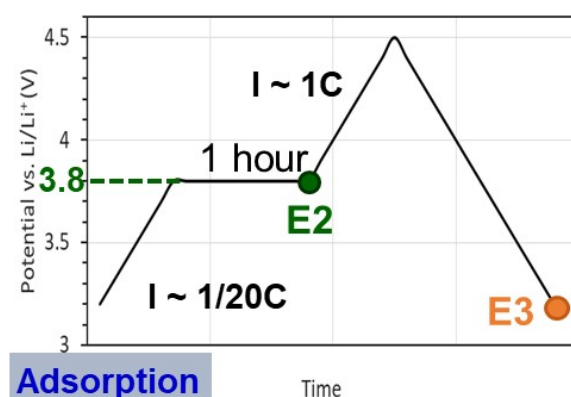


Figure S1: The scheme of electrochemical experiments on the LMO cathode using a three-electrode beaker cell.

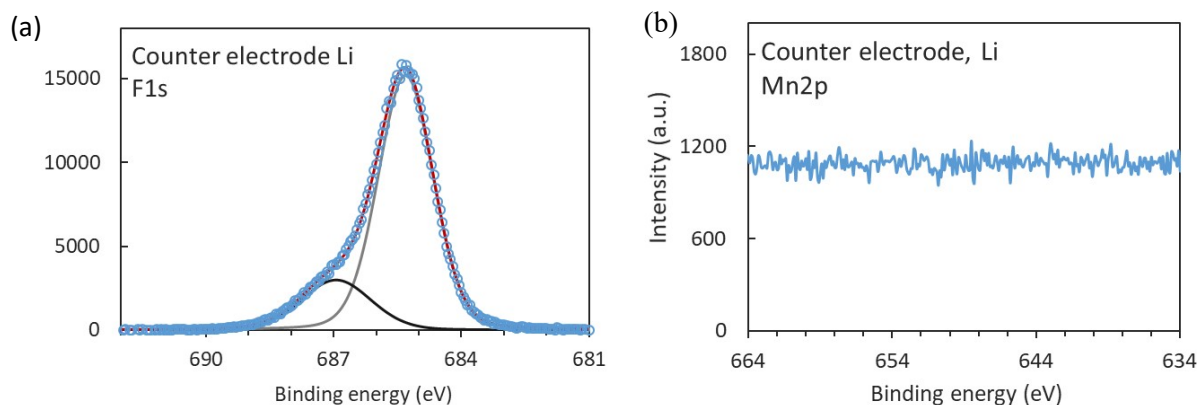


Figure S2: (a) Analysed F1s and (b) Mn2p XPS spectra of counter electrode, Li foil, after electrochemical reaction until 3.8V vs  $\text{Li}^+/\text{Li}$  in an electrolyte solution of 1.1 M  $\text{LiPF}_6$  in DEC/EC/PC (70/25/5, v/v). As seen in the left figure, two peaks appeared in the F1s region, which could be assigned to LiF (685.3 eV) and  $\text{Li}_x\text{PO}_y\text{F}_z$  (687.2 eV). No peak appeared in the Mn2P region showing the absence of  $\text{MnF}_2$  (right figure).

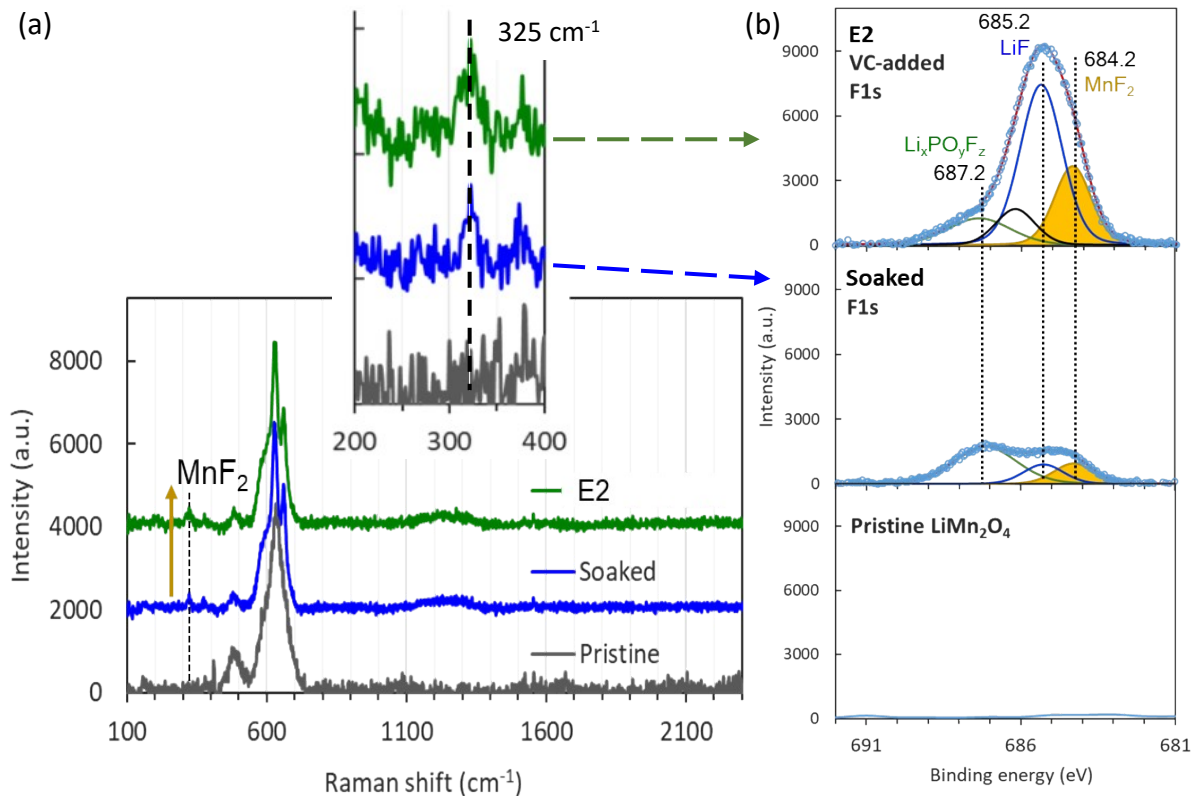


Figure S3: (a) Raman spectra of the pristine  $\text{LiMn}_2\text{O}_4$  (LMO) (grey line), the soaked LMO in the VC-free electrolyte (blue line), and the LMO cathode after the electrochemical reaction until E2 employing the VC-free electrolyte (green line). The peaks at 483, 580, 625, and 658  $\text{cm}^{-1}$  were corresponding to LMO thin film [Ref. C. V. Ramana et al., Surf. Interface Anal. 37 (2005) 412–416]. The insertion is the enlarge figure of the range 200 – 400  $\text{cm}^{-1}$  Raman shift. (b) A comparison of corresponding F1s spectra of the pristine LMO, the soaking and E2 samples using the VC-free electrolyte.

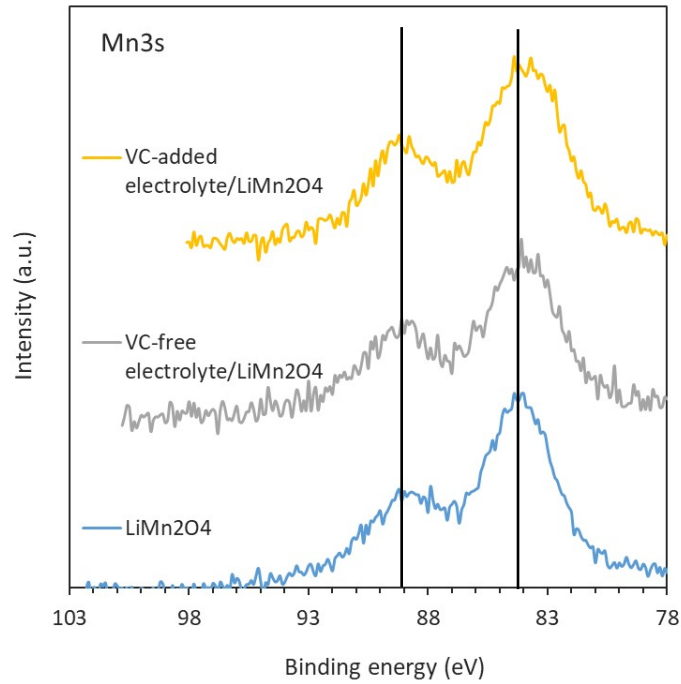


Figure S4: Mn3s XPS spectra of pristine LiMn<sub>2</sub>O<sub>4</sub> surface and the LiMn<sub>2</sub>O<sub>4</sub> after soaking in VC-free electrolyte and VC-added electrolyte.

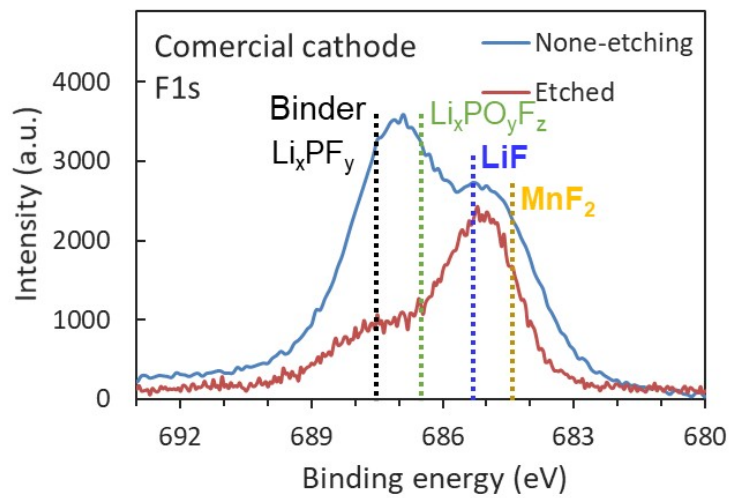


Figure S5: F1s spectra of supplied commercial LMO cathode after the pretreatment process employing VC-added electrolyte as received and after argon etching for 5 minutes.

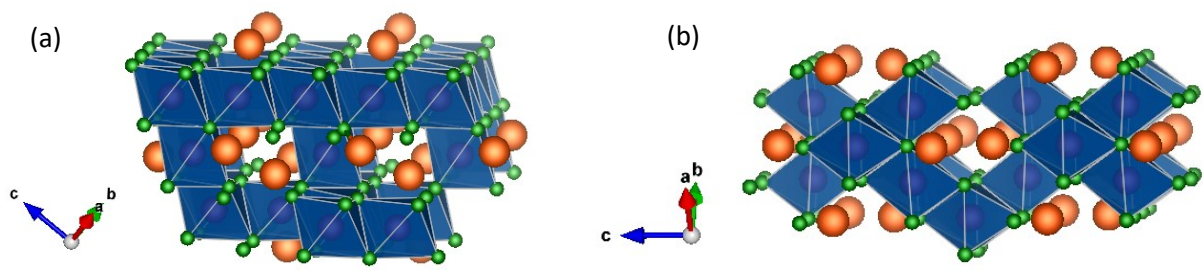


Figure S6: Lattice orientation of LMO in (a) the (111) plane and (b) (110) plane, in which blue polyhedron are  $\text{MnO}_4$ , green spheres are oxygen sites, and orange spheres are lithium sites.