

# Supporting information

| h | k | l | d     |
|---|---|---|-------|
| 0 | 0 | 3 | 4.683 |
| 1 | 0 | 1 | 2.401 |
| 0 | 0 | 6 | 2.341 |
| 0 | 1 | 2 | 2.303 |

Lithium cobalt oxide:  
Hexagonal structure,  
 $a = 2.815\text{\AA}$ ,  $c = 14.05\text{\AA}$

| h | k | l | d     |
|---|---|---|-------|
| 1 | 1 | 1 | 2.460 |
| 2 | 0 | 0 | 2.13  |
| 3 | 1 | 1 | 1.284 |
| 2 | 2 | 2 | 1.230 |

Cobalt (II) oxide:  
Rock-salt structure,  
 $a = 4.2615\text{\AA}$

Table 1: Crystal structure and d-spacing parameters for LCO and Co(II)O. The values shown in red are denoted in the TEM images

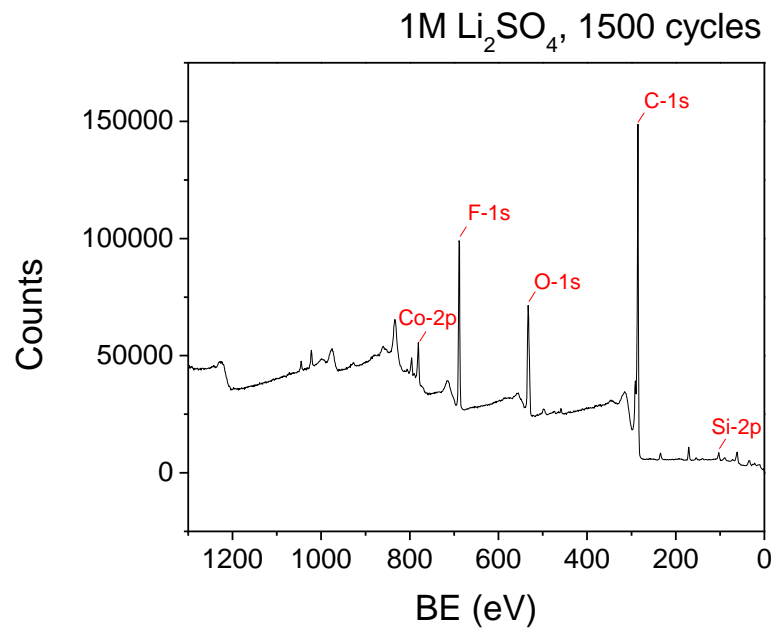
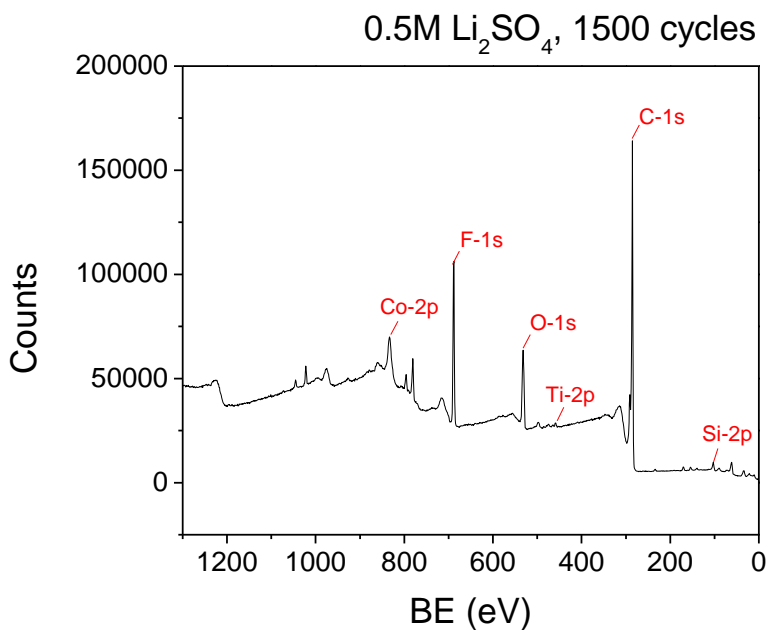
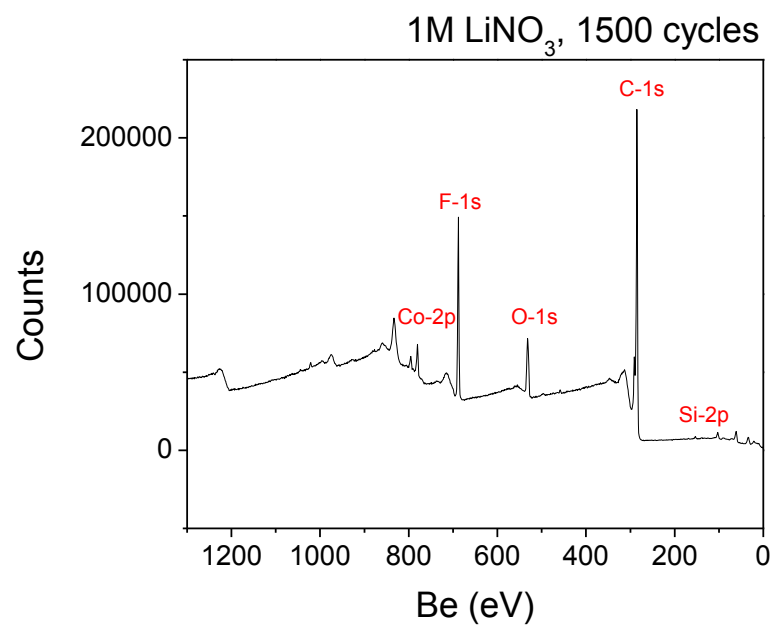
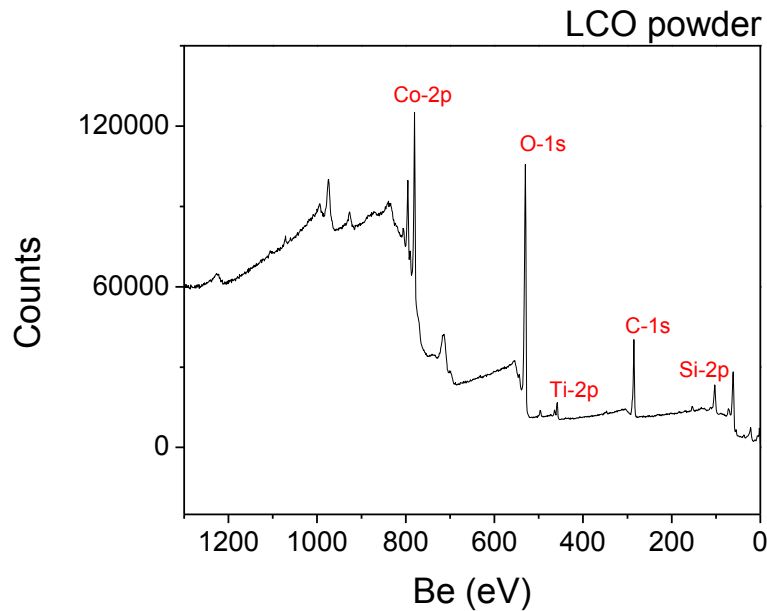


Figure S1. Detailed XPS scans for (a) Uncyclized LCO powder, (b), (c), (d) LCO cycled in 1M  $\text{LiNO}_3$ , 0.5M  $\text{Li}_2\text{SO}_4$  and 1M  $\text{Li}_2\text{SO}_4$  respectively

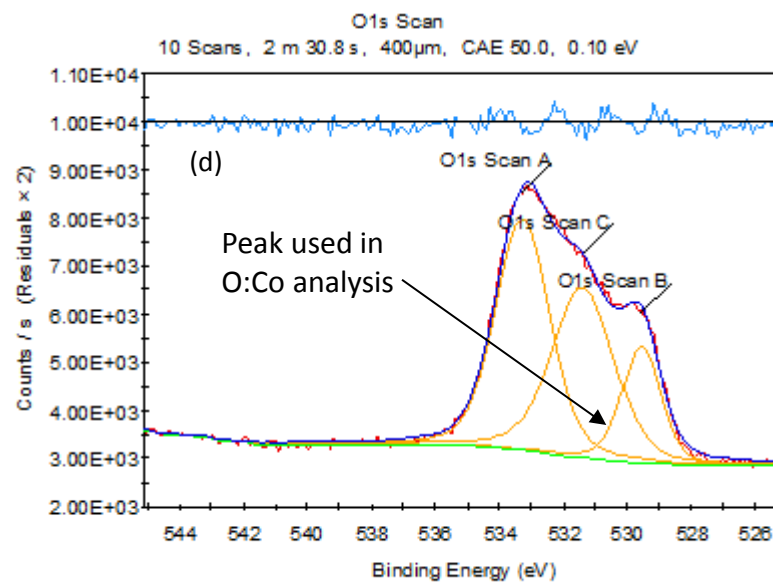
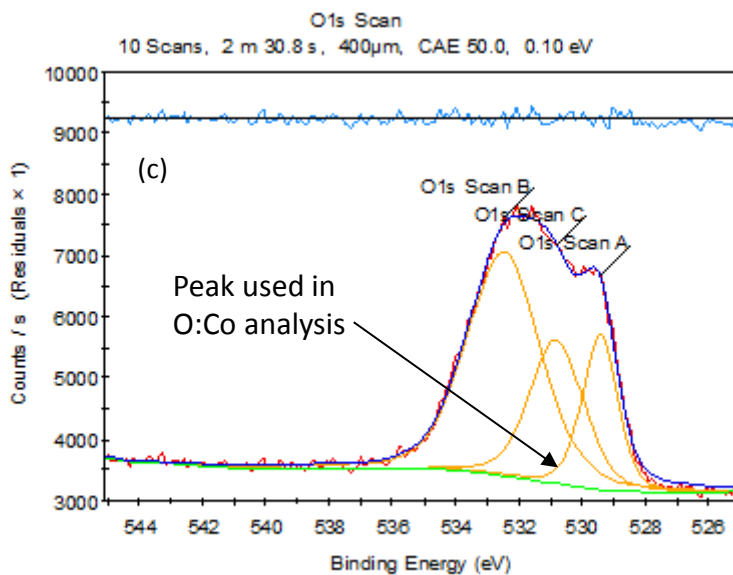
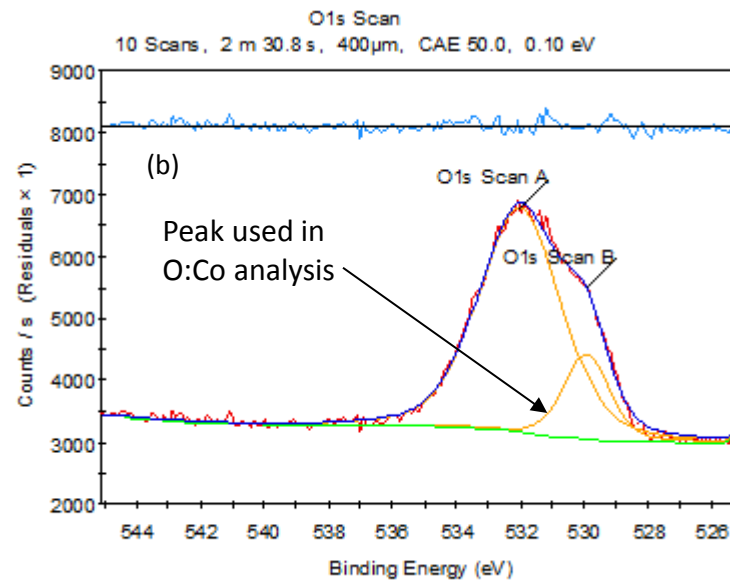
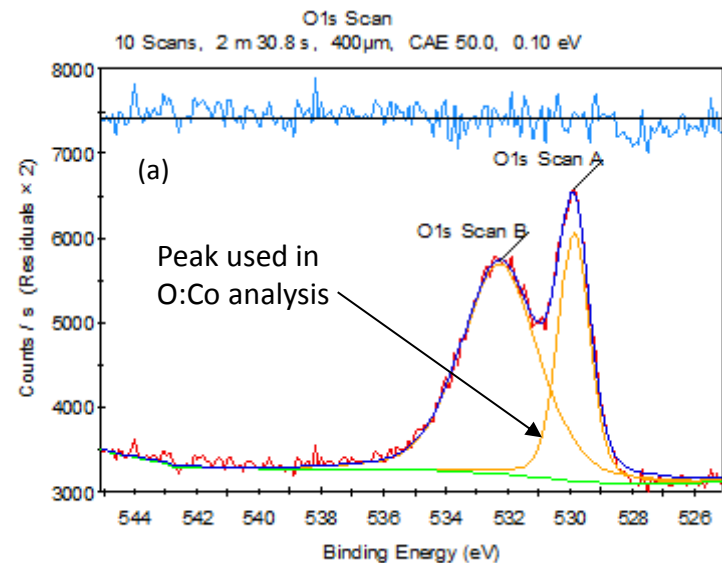


Figure S2: XPS spectra for O-1s peaks in (a) pure LCO and electrodes cycled in different (b) 1M  $\text{LiNO}_3$ , (c) 0.5M  $\text{Li}_2\text{SO}_4$  and (d) 1M  $\text{Li}_2\text{SO}_4$  for 1500 cycles.

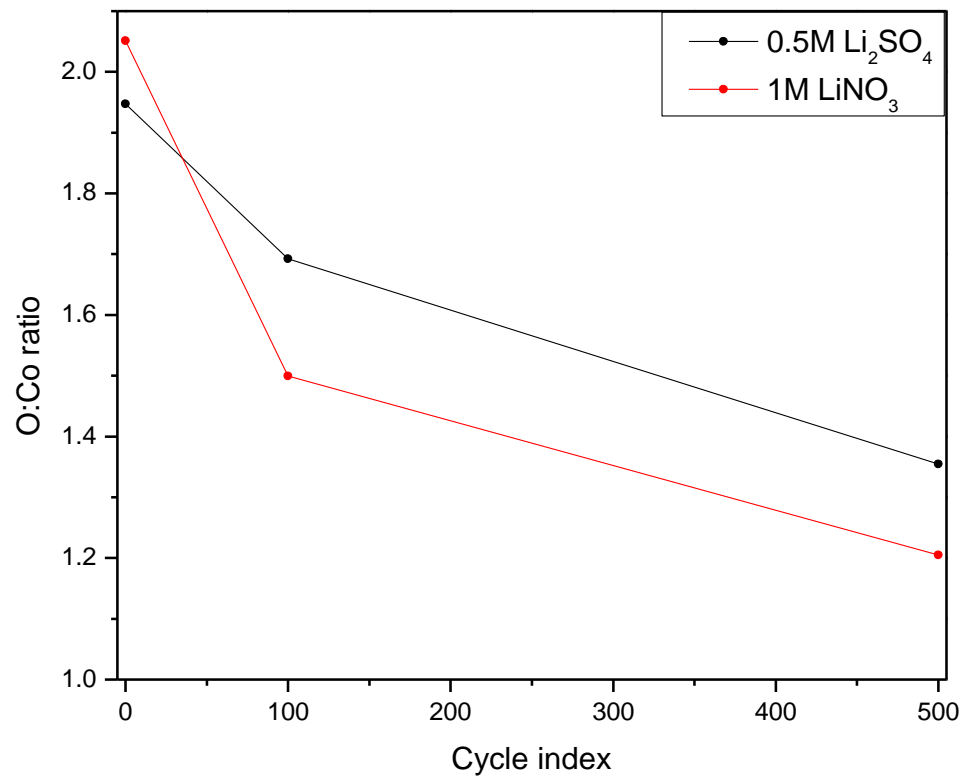


Figure S3: XPS-calculated O:Co ratio of the surface of LCO electrodes cycled in different electrolytes for 1, 100 and 500 cycles.