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## **Supporting Information for**

## Highly stable lithium metal battery applied three-dimensional mesh structure interlayer

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Table S1 Properties of stainless steel mesh

304 Stainless Steel Meshed Disc (SSM)

Material	Stainless Steel. Purity > 99.9 %				
Diameter	15 mm				
Thickness	0.15 mm				

Stainless Steel	С	Si	Mn	Р	S	Ni	Cr
SUS 304	0.08	1.00	2.00	0.045	0.03	8.00~10.50	18.00~20.00



Figure S1. SEM image of Cu foil



**Figure S2.** The voltage profile of half-cell test during initialization process. The batteries were first cycled at 0–1 V (vs. Li<sup>+</sup>/Li) at 50  $\mu$ A for five cycles for initialization to remove surface contaminations and stabilize the interface.



Figure S3. Schematic illustrations of half-cell tests.



Figure S4. Schematic illustrations of symmetrical cell tests.



**Figure S5.** Symmetrical cell tests. (a) The voltage profile with the bare Li metal(black) and Li/SSM(red) electrode between 200 hours and 210 hours at 1 mA cm<sup>-2</sup> (b) The voltage profile with the bare Li metal(black) and Li/SSM(red) electrode between 200 hours and 210 hours at 5 mA cm<sup>-2</sup>



Figure S6. The voltage hysteresis in symmetric Li/SSM cells



Figure S7. Cyclability of LiFePO<sub>4</sub>/Li cell.



Figure S8. Resistance of stainless steel mesh



Figure S9. The voltage hysteresis at 1mA cm<sup>-2</sup> with different mesh size

	Coulombic efficiency at 1mAh	Voltage range of symmetrical cell at 1mA cm <sup>-2</sup>	Voltage range of symmetrical cell at 5mA cm <sup>-2</sup>	Need of current collector
This work	98.35 % (Without additive)	-0.015 V ~ 0.015 V	-0.025 V ~ 0.025 V	Х
Adv. Mater. 2016, 28, 6932–6939	97 % (Without additive)	-0.05 V ~ 0.05 V	Х	0
Adv. Funct. Mater. 2017, 27, 1606422	93.8 % (With additive, 1 wt% LiNO <sub>3</sub> )	-0.2 V ~ 0.2 V	Х	Х
Adv. Mater. 2017, 29, 1700389	98 % (With additive, 1wt% LiNO <sub>3</sub> )	-0.04 V ~ 0.04 V	Х	0
Adv. Mater. 2016, 28, 2888-2895	97 % (With additive, 2 wt% LiNO <sub>3</sub> )	Х	Х	Х

 Table S2.
 The electrochemical stability comparison.