

Supplementary Data

Regulating Li-ion flux with high-dielectric hybrid artificial SEI for stable Li metal anode

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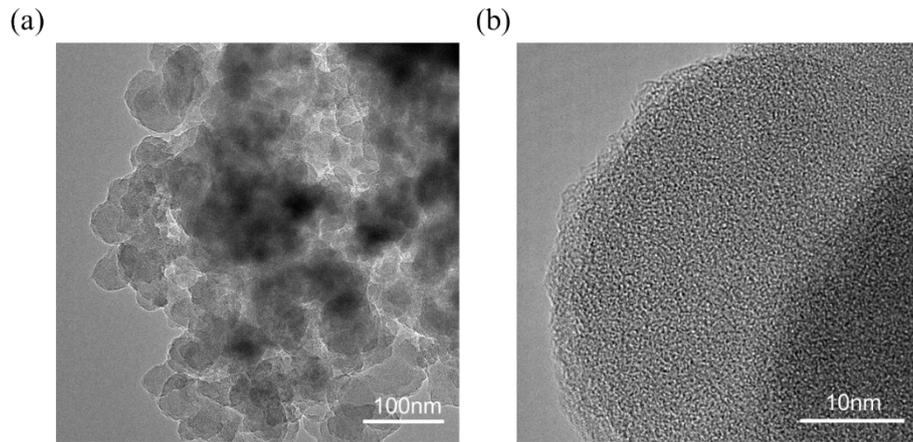


Fig S1. TEM images of 30 nm SiO₂ on the scale of (a) 100nm and (b) 10 nm.



Fig S2. The uniform dispersion of SiO₂ nanoparticles within the buffer solution.

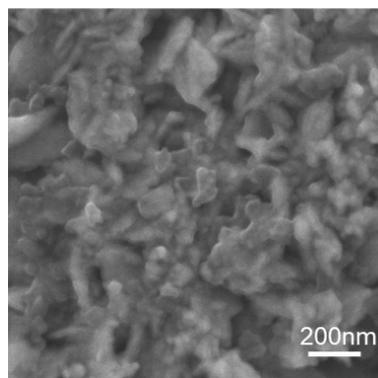


Fig S3. SEM image of the SiO₂@PDA overlayer.

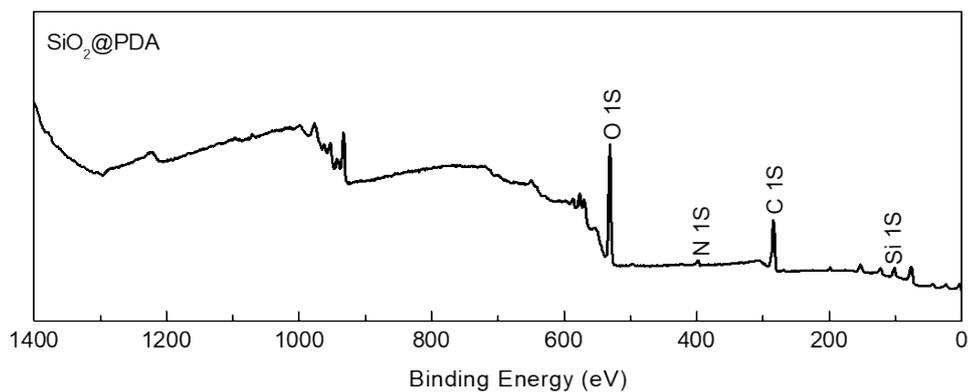


Fig S4. The full XPS spectra of SiO₂@PDA film.

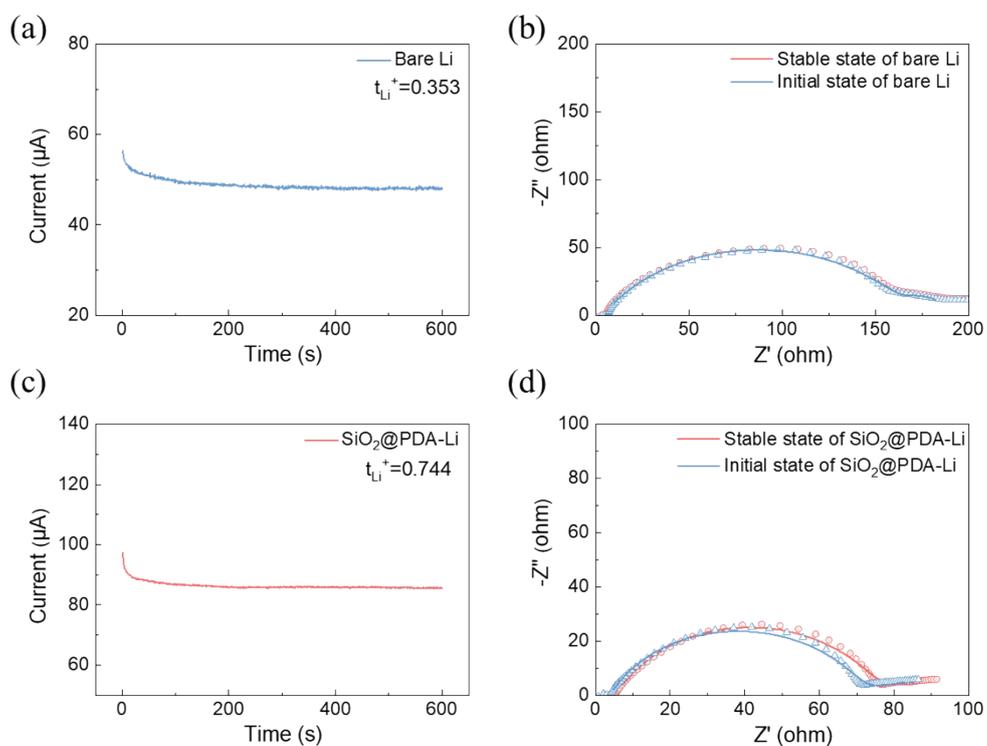


Fig S5. (a) Current relaxation at 10 mV polarization of a symmetric lithium cells with bare Li and (c) for SiO₂@PDA-Li; (b) Nyquist plots of initial state and stable state for bare Li and (d) for SiO₂@PDA-Li.

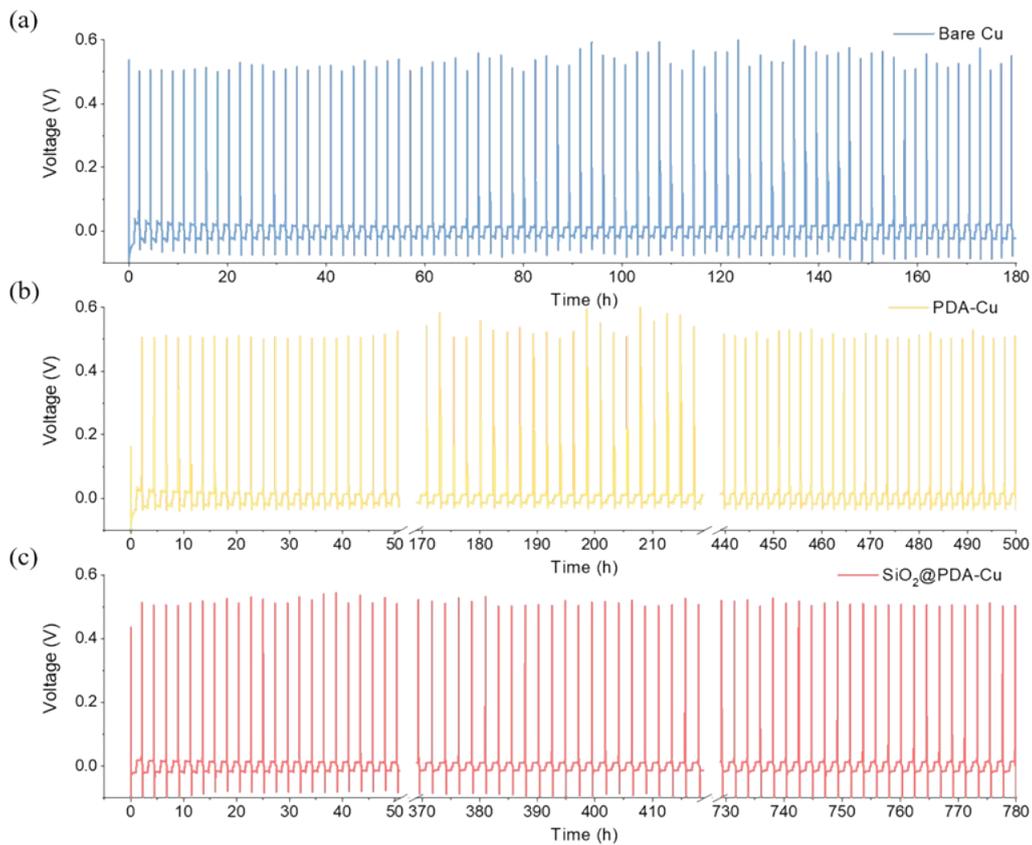


Fig S6. Li||Cu half-cells assembled with Bare Cu foils (a), PDA-Cu (b), and SiO₂@PDA-Cu (c) with the voltage profiles of undergoing full plate-strip tests at current densities of 0.4 mA cm⁻² with area capacity of 0.4 mAh cm⁻².

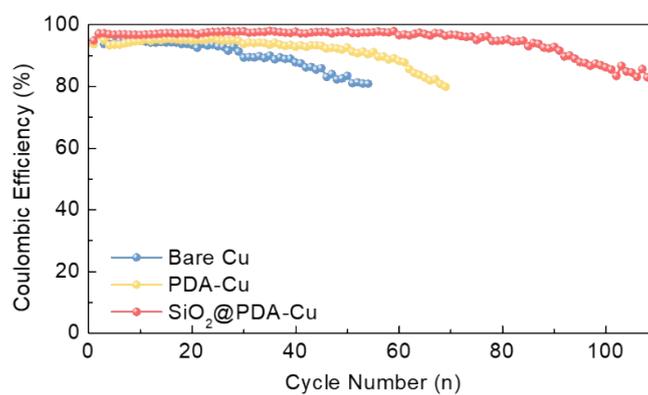


Fig S7. Coulombic efficiency of Li||Cu half-cells at current density at 0.8 mA cm⁻² with area capacity of 0.8 mAh cm⁻².

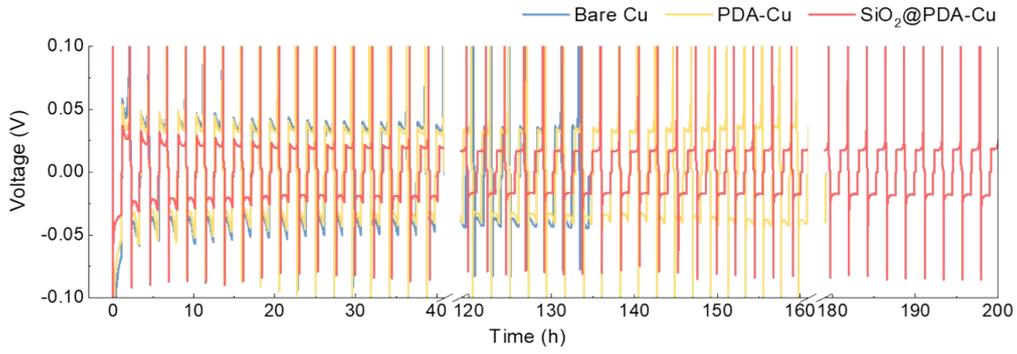


Fig S8. The voltage profiles of three Li||Cu half-cells undergoing full plate-strip tests at current densities of 0.8 mA cm^{-2} with area capacity of 0.8 mAh cm^{-2} .

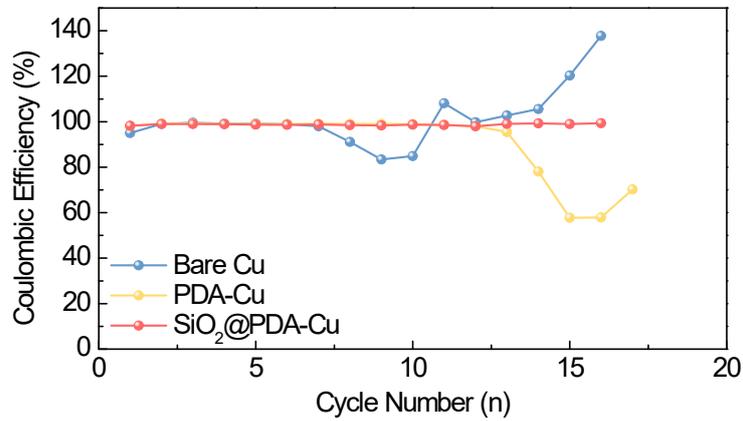


Fig S9. Coulombic efficiency of Li||Cu half-cells at current density at 0.8 mA cm^{-2} with area capacity of 6 mAh cm^{-2} .

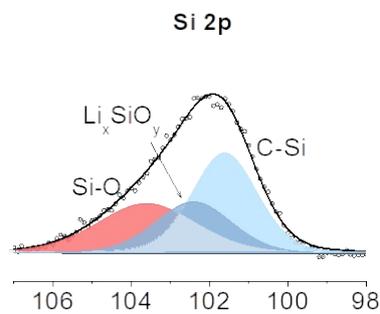


Fig S10. Si 2p XPS spectra of $\text{SiO}_2@\text{PDA-SEI}$.

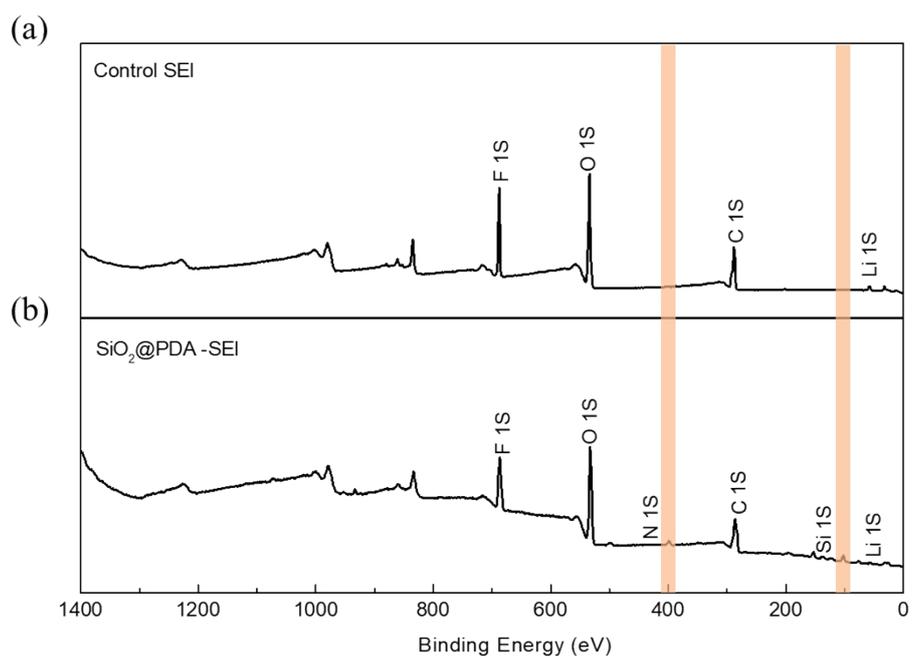


Fig S11. The full XPS spectra of (a) control SEI and (b) SiO₂@PDA-SEI.

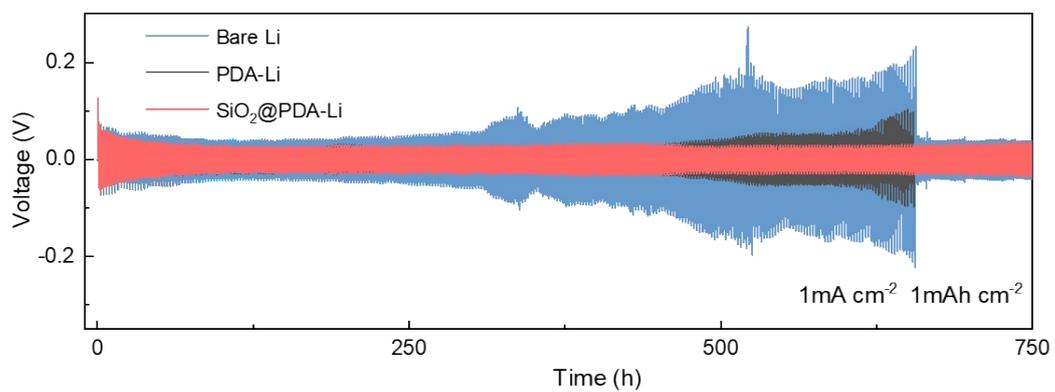


Fig S12. Voltage–time profiles of Li||Li cells with and without SiO₂@PDA overlayer at 1 mA cm⁻², 1 mAh cm⁻².

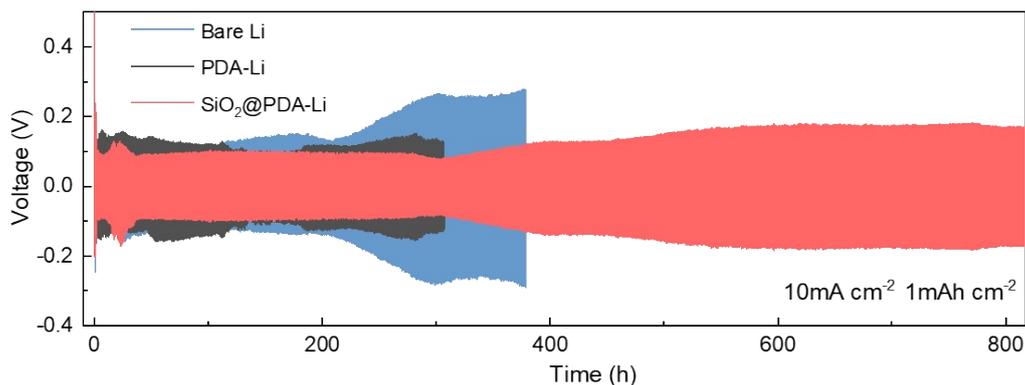


Fig S13. Voltage–time profiles of Li||Li cells with and without SiO₂@PDA overlayer at 10 mA cm⁻², 1 mAh cm⁻².

Table S1. Cyclic stability comparison of the SiO₂@PDA film with previous works

| Strategies of Li anode | Current density (mA cm ⁻²) | Areal capacity (mAh cm ⁻²) | Cycle time (h) | References |
|---|--|--|----------------|------------|
| PVDF-HFP/LiF film | 1 | 1 | 200 | 44 |
| Li-11 wt% Sr alloy anode and SrF ₂ -rich SEI | 1 | 1 | 280 | 42 |
| PPSP layer | 1 | 1 | 320 | 40 |
| COF-based artificial SEI layer | 1 | 1 | 400 | 45 |
| C ₆ F ₃ LiN ₄ adjust SEI | 1 | 1 | 700 | 37 |
| Polymer of intrinsic microporosity (PIM) | 1 | 1 | 720 | 41 |
| 3D structural network of GFs layer | 1 | 1 | 800 | 46 |
| hybrid poly urea (HPU) film | 5 | 1 | 90 | 39 |
| nano-AlPO ₄ /PVDF-HFP composite film (PAF) | 5 | 1 | 200 | 43 |
| LiPEO–UPy coating | 5 | 1 | 2000 | 38 |
| q-PET nonwoven fabric film | 10 | 1 | 100 | 17 |
| Li-11 wt% Sr alloy anode and SrF ₂ -rich SEI | 10 | 1 | 200 | 42 |
| SiO ₂ @PDA hybrid film | 1 | 1 | Over 750 | This work |
| | 5 | 1 | 2800 | |
| | 10 | 1 | 800 | |