**Electronic Supplementary Information**

# Towards Cost-Effective Silicon Anode Using Conductive Polyaniline-Encapsulated Silicon Micropowders

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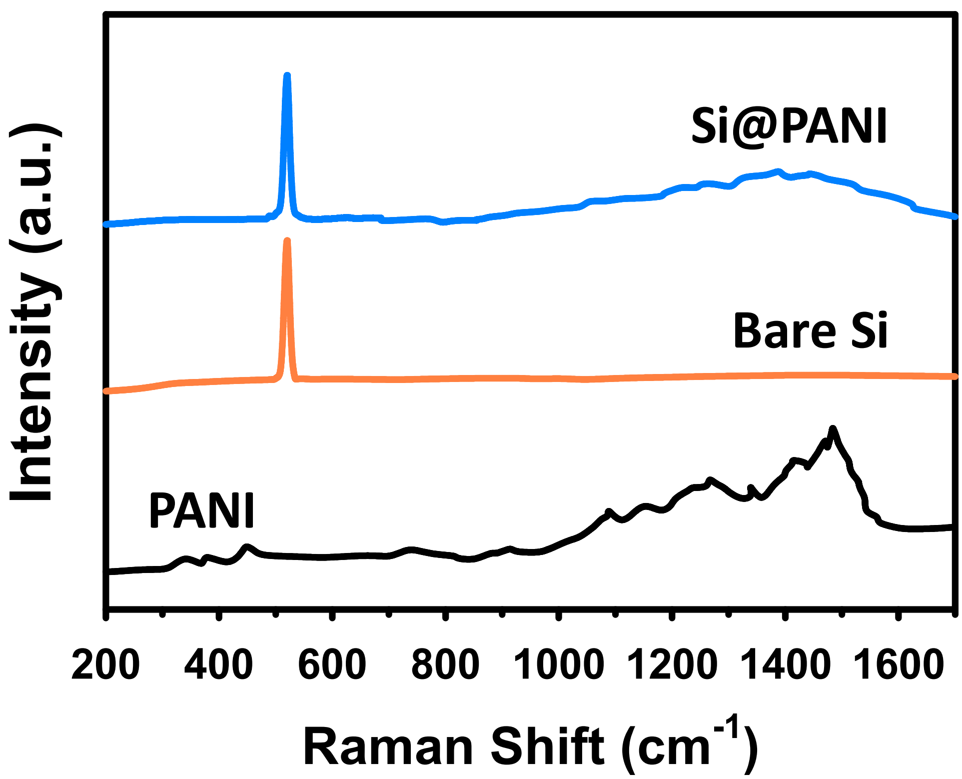


**Fig. S1.** Raman spectra of bulk PANI and Si particles with and without PANI coating.

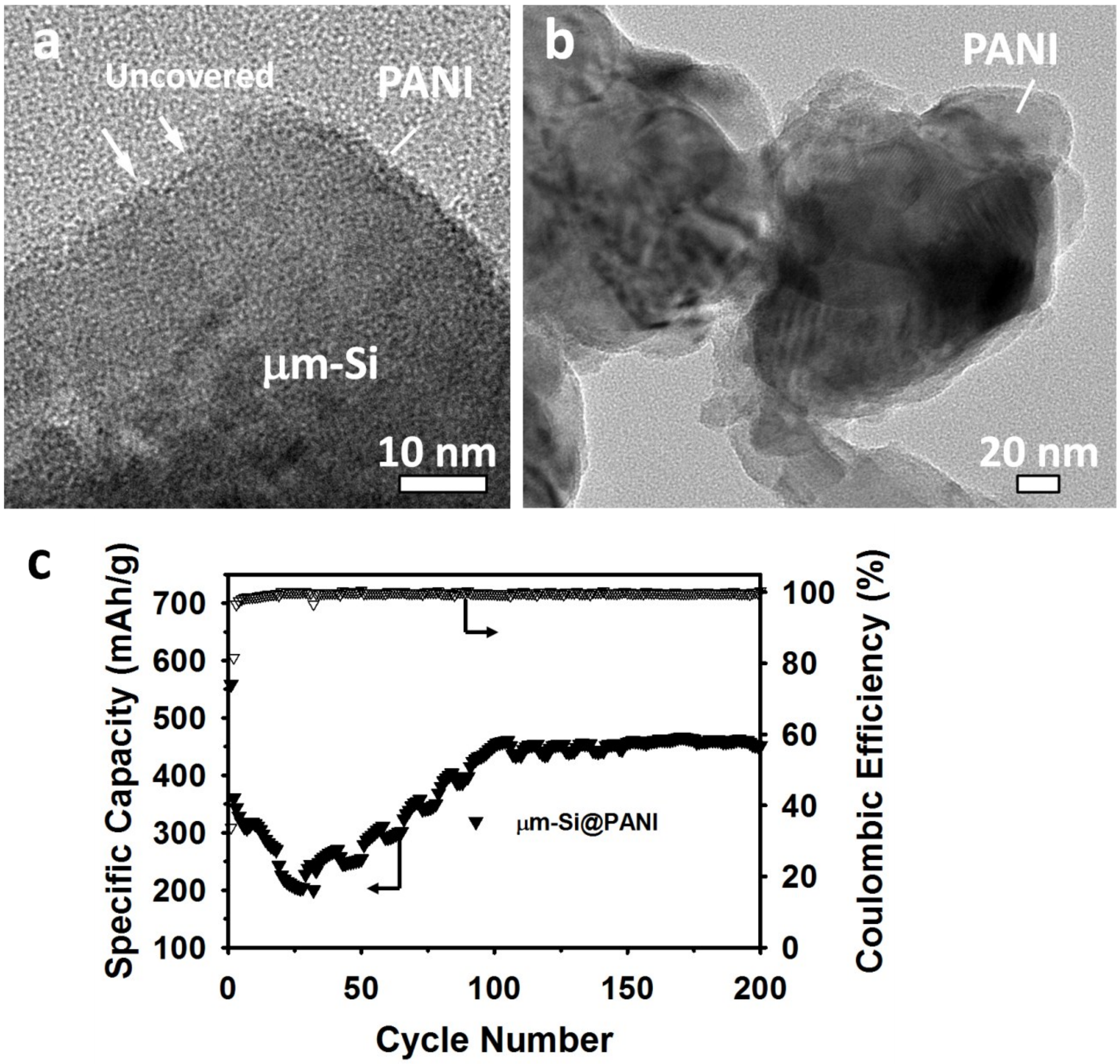


**Fig. S2.** TEM images of PANI coated μm-Si particles prepared with (a) reduced concentration of aniline by 50% highlighting the exposed regions of Si surface, and (b) doubled concentration of aniline showing the excess PANI coating. (c) Delithiation capacity (solid) and coulombic efficiency (open) of electrodes prepared using μm-Si particles with excess PANI coating cycled from 1.5 V to 0.02 V at a current density of 0.5 A/g.

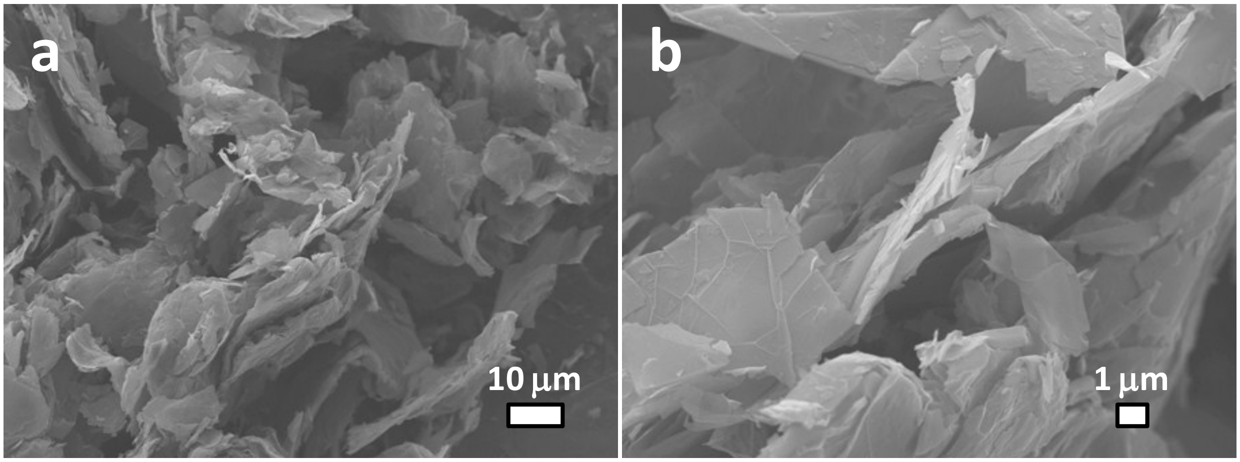


**Fig. S3.** SEM images of partially exfoliated graphite flakes with a diameter of 20-50 μm along the basal plane.

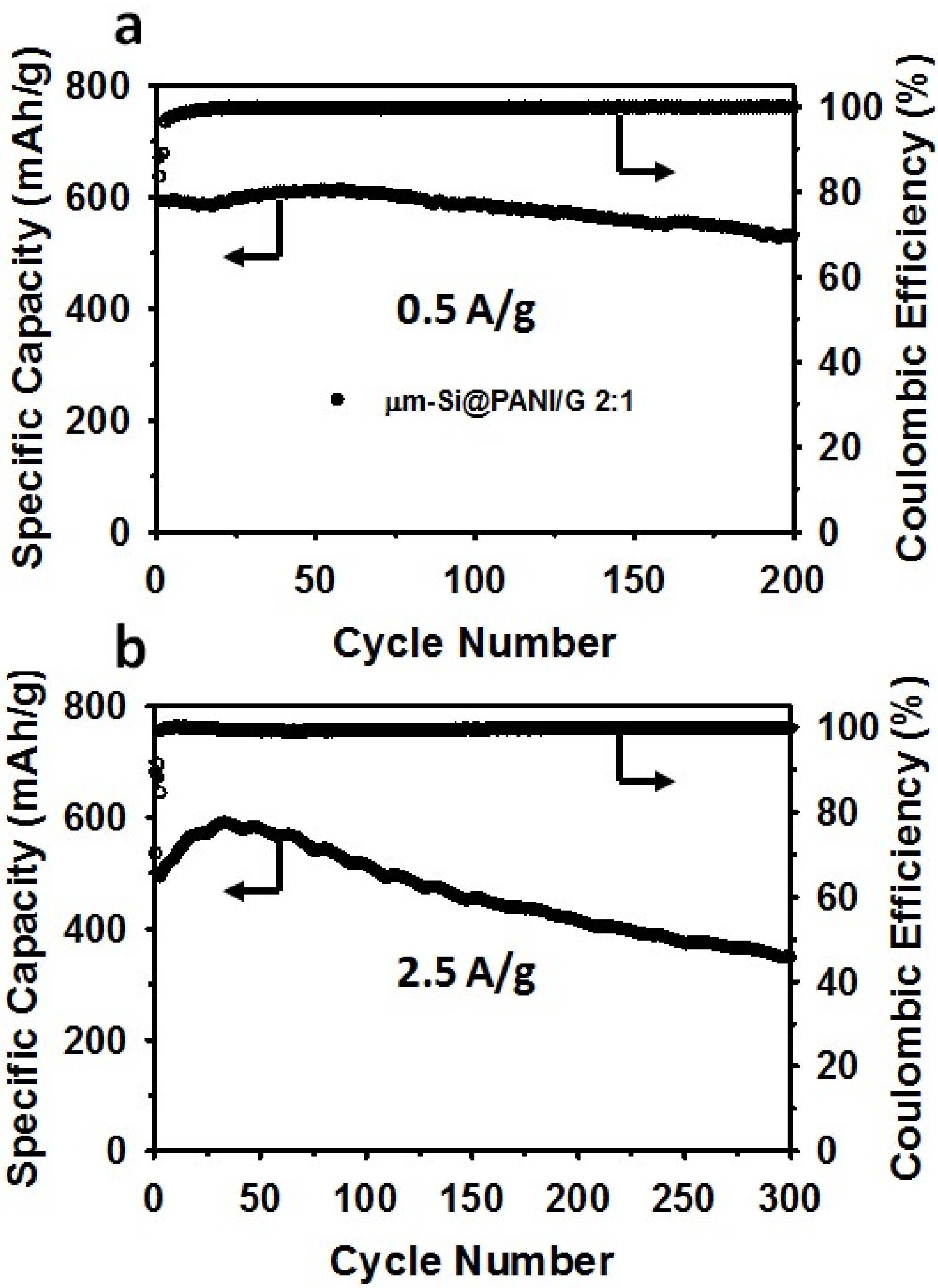


**Fig. S4.** Delithiation capacity (solid) and coulombic efficiency (open) of stored PANI coated µm-Si/graphite composite electrodes cycled at current densities of (a) 0.5 A/g and (b) 2.5 A/g. The electrodes were exposed in air with a relative humidity of ~60% for 60 days, and then vacuum dried at 90°C overnight prior to testing. Capacity is calculated using the total mass of Si, PANI and graphite.

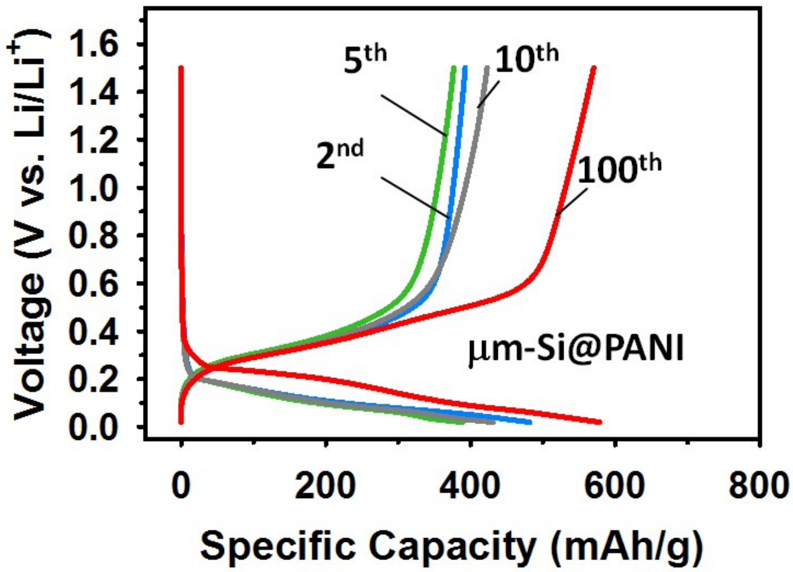


**Fig. S5.** Galvanostatic charge/discharge voltage profiles of PANI coated μm-Si electrodes at a constant current density of 0.5 A/g.

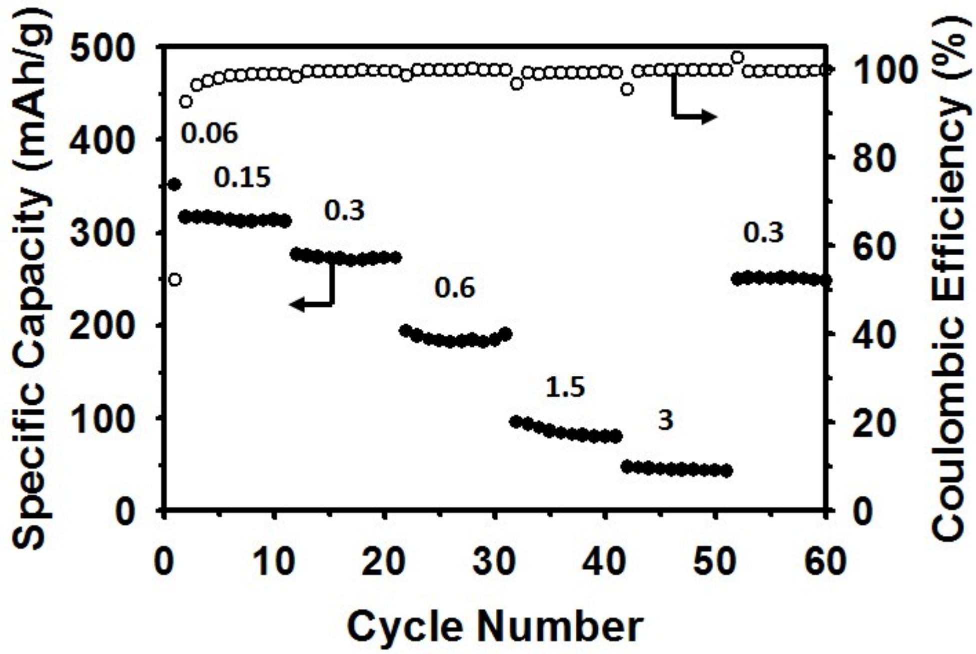


**Fig. S6.** Delithiation capacity (solid) and coulombic efficiency (open) of partially exfoliated graphite flakes cycled at various current densities (A/g) as labeled.

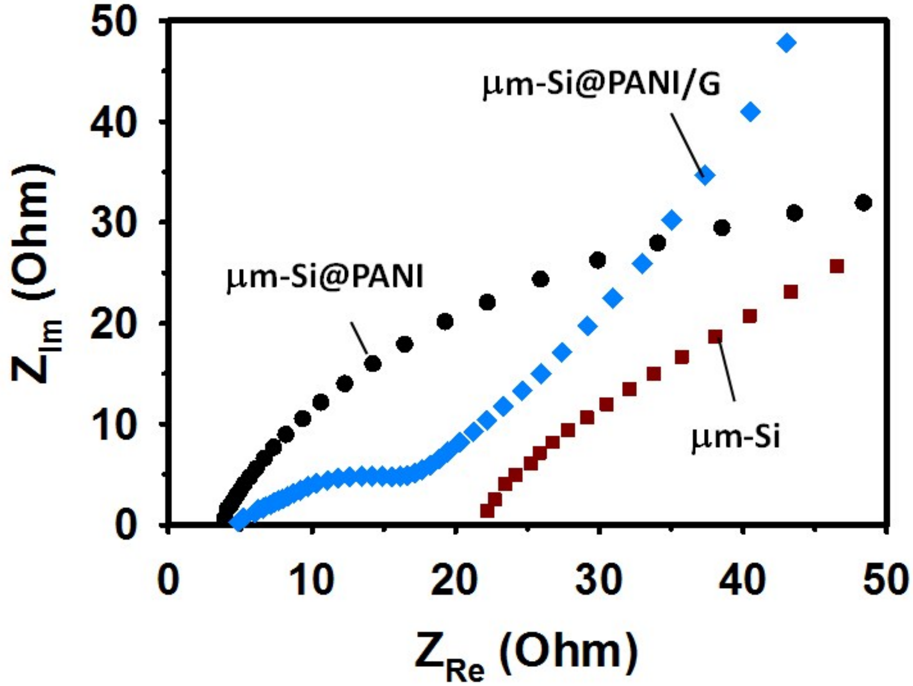


**Fig. S7.** The high frequency region of the Nyquist plots showing the internal resistance of the bare μm-Si, PANI coated μm-Si and PANI coated μm-Si/graphite composite electrodes after 50 cycles.

| Cycle No. | Charge voltage (V) | | Discharge voltage (V) | | Voltage hysteresis (V) | |
|---|---|---|---|---|---|---|
| | μm-Si@PANI/G | μm-Si@PANI | μm-Si@PANI/G | μm-Si@PANI | μm-Si@PANI/G | μm-Si@PANI |
| 2 | 0.344 | 0.355 | 0.110 | 0.095 | 0.234 | 0.260 |
| 5 | 0.348 | 0.369 | 0.112 | 0.098 | 0.236 | 0.271 |
| 10 | 0.355 | 0.376 | 0.119 | 0.096 | 0.236 | 0.280 |
| 100 | 0.390 | 0.416 | 0.152 | 0.147 | 0.238 | 0.269 |

**Table S1.** Nominal voltage of charge/discharge (delithiation/lithiation) cycles of PANI coated μm-Si composites with and without graphite at a constant current density of 0.5 A/g.

| | RAW MATERIALS | COST PER KG |
|---|---|---|
| | Si nanopowders (~100 nm) | $4,000 |
| | Solar-grade Si | $10 |
| | Ammonium persulfate | $74 |
| | L-phenylalanine | $451 |
| | aniline | $160 |
| | Graphite flake | $5 |
| | | |
| | Ball mill process[1] | |
| | Electricity | $3.6[2] |
| | NMP | $19 |
| | | |
| **SUM COST** | nm-Si@PANI | $3,050 per kg |
| **PER UNIT CAPACITY** | 1100 mAh/g | $2.8 per Ah |
| **SUM COST** | μm-Si@PANI/G | $102 per kg |
| **PER UNIT CAPACITY** | 600 mAh/g | $0.17 per Ah |

1. Total output of each single batch was 320 g of Si powders.
2. A single ball milling experiment consumed 24 kWh of electricity, at a local electricity unit price of $0.15 USD per kWh.

**Table S2.** Cost estimation of nm-Si and μm-Si anodes developed in our work. The retail price of artificial graphite (US only) is typically $0.10 per Ah.