# A Si@SiOC@$Li_2Si_2O_5$ Anode Derived from Pyrolysis of Polysiloxane Enables Lithium-ion Batteries with High Electrochemical Performance and High Initial Coulombic Efficiency

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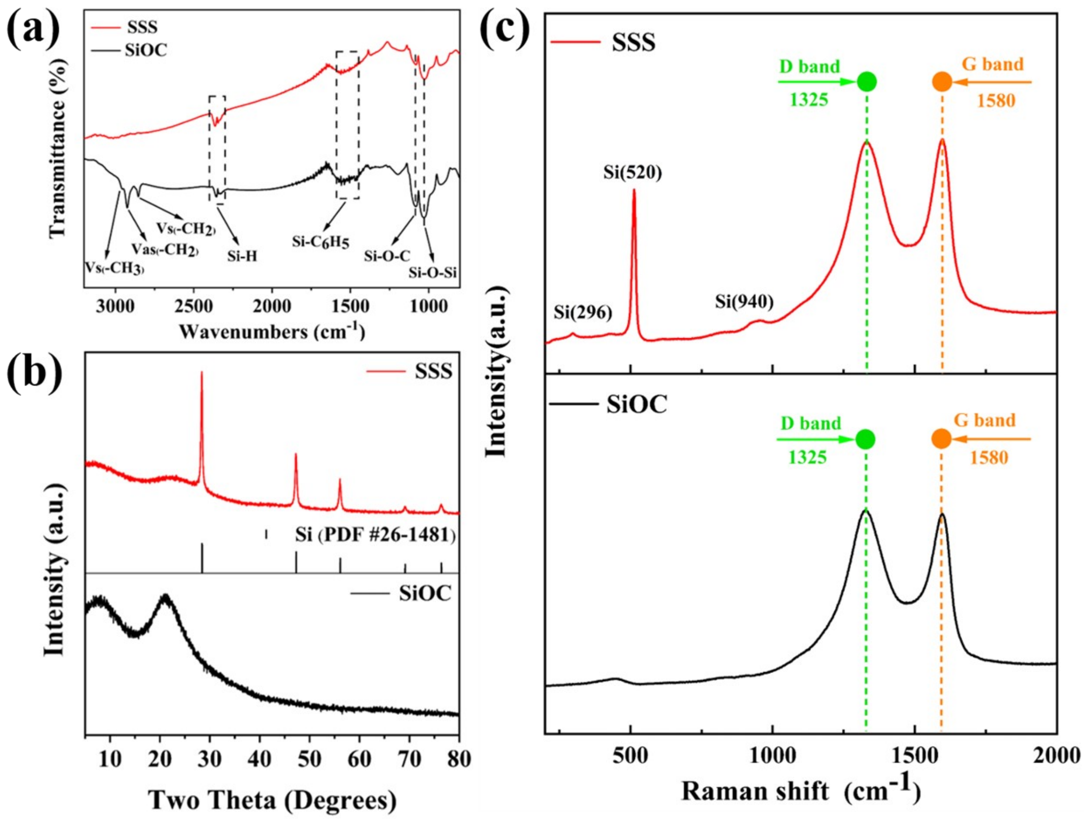


Figure S1. (a) FT-IR spectra of the SiOC and SSS. (b) XRD patterns of the SiOC and SSS. (c) Raman spectra of the SiOC and SSS.

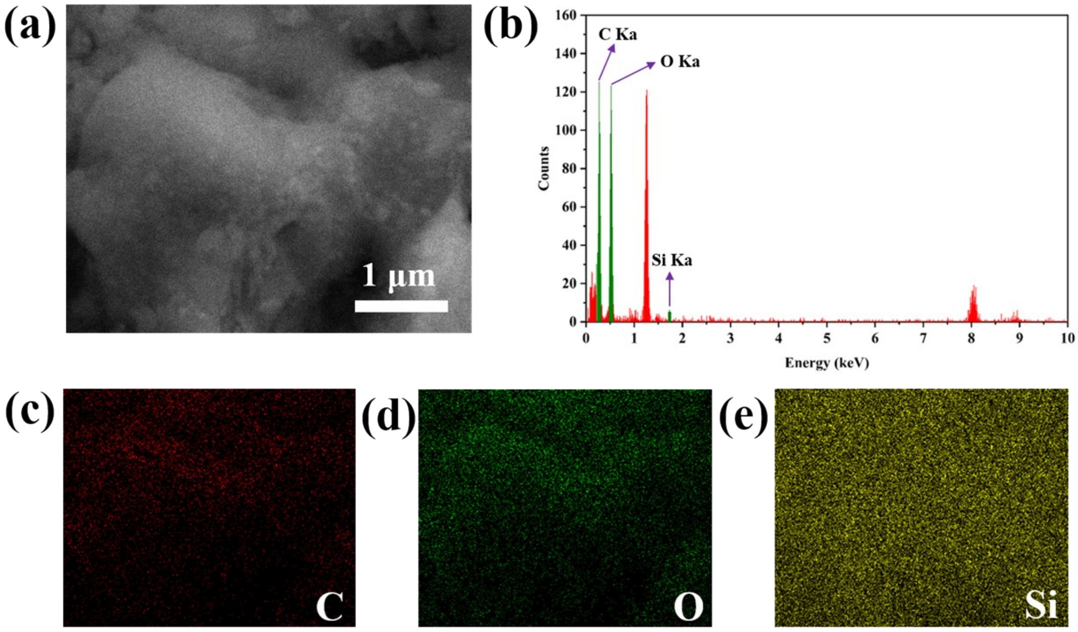


Figure S2. Element distribution spectra of the SSL.

Table S1. Electrochemical performance of SiOC-based composites.

| Sample (current density mA $g^{-1}$) | First reversible capacity (mAh $g^{-1}$) | ICE(%) | Reversible capacity (after N cycles) | Reference |
|---|---|---|---|---|
| **Pure SiOC** | | | | |
| SiOC–Ar (36) | 760 | 50 | >400 (100) | Graczyk-zajac et al. 2018 (ref. 1) [1] |
| SiOC-DVB-1 (100) | 819 | 65 | 476 (500) | Wu et al. 2022 (ref. 2) [2] |
| SiOC-500 (100) | 578 | 57 | 351 (200) | Xia et al. 2020 (ref. 3) [3] |
| **Carbon based SiOC composites** | | | | |
| SiOC:C nanohybrids (50) | 436 | 54 | 470 (50) | Wang et al. 2015 (ref. 4) [4] |
| SiOC/C NF-0.5(100) | 1011 | 68 | 707 (200) | Huang et al. 2021 (ref. 5) [5] |
| Onion-like SiOC/C (100) | 658 | 78 | 540 (50) | Lin et al. 2022 (ref. 6) [6] |
| **Graphite based SiOC composites** | | | | |
| SiOC/graphite (SG)(50) | 580 | 71 | 480 (1000) | Wu et al. 2019 (ref. 7)[7] |
| NCG@SiOC (372) | 520 | 72 | 300 (1000) | Hong et al. 2021 (ref. 8) [8] |
| SiOCPhTES/C10g (186) | 452 | 54 | 293 (20) | Knozowski et al. 2020 (ref. 9) [9] |
| **Graphene oxide/reduced graphene oxide/graphene based SiOC composites** | | | | |
| SiOC@C/graphene(200) | 674 | 62 | 691 (100) | Ma et al. 2022 (ref. 10) [10] |
| 3D GNS SiOC (100) | 844 | 66 | 701 (100) | Sang et al. 2018 (ref. 11) [11] |
| NGA SiOC 25 (37) | 747 | 67 | 605 (90) | Shao et al. 2020 (ref. 12) [12] |
| **Si/SiOC composites** | | | | |
| SiOC. N–Si-a (74) | 704 | - | 620 (100) | Kaspar et al. 2014 (ref. 13)[13] |
| Sitc:SiOC (-) | 593 | 65 | 289 (50) | Vrankovic et al. 2017 (ref. 14) [14] |
| Si/SiOC-0.6 (100) | 980 | 63 | 800 (100) | Wu et al. 2019 (ref. 15) [15] |
| **Sn/SiOC composites** | | | | |
| 1.1 Sn- SiOCfiber | 939 | 82 | 457 (100) | Tolosa et al. 2018 (ref. 16)[16] |
| Sn@SiOC NPs (186) | 656 | 67 | 411 (250) | Xia et al. 2020 (ref. 17) [17] |
| SiOC:C0.2/Sn-40% (100) | 439 | 56 | 351 (100) | Knozowski et al. 2022 (ref. 18) [18] |
| **This work** | | | | |
| Si@$SiO_x$ (500) | 2773 | 87 | 0 (80) | |
| SSL (500) | 983 | 73 | 733 (500) | |
| SiOC (500) | 639 | 55 | 205 (500) | |
| SSS (500) | 1082 | 70 | 170 (500) | |

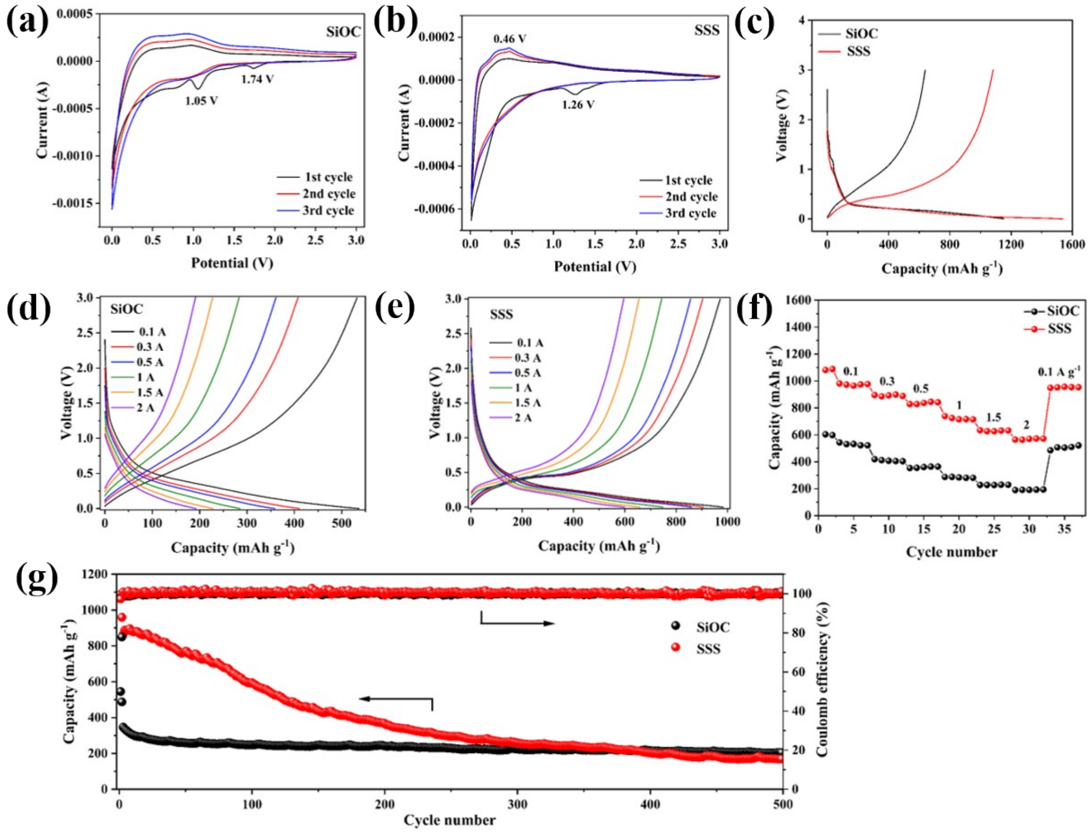


Figure S3. The CV curves for the initial three cycles of (a)SiOC, (b) SSS between 3.0 and 0.001 V (vs. $Li/Li^{+}$) at a scan rate of 0.1 mV $s^{-1}$. (c) ICE the SiOC and SSS anodes. Charge/discharge voltage profiles of (d) SiOC, (e) SSS electrodes at specific current values from 0.1 to 2 A $g^{-1}$. (f) Rate performance of the SiOC and SSS anodes. (g) Cycling performance of SiOC and SSS electrodes at 0.5 A $g^{-1}$.

Table S2. $R_{ct}$ and $R_s$ values for Si@$SiO_x$, SSL, SiOC and SSS electrodes in EIS tests.

| Electrode material | Rct/Ω | Rs/Ω |
|---|---|---|
| Si@$SiO_x$-1st | 28.95 | 3.885 |
| SSL-1st | 6.132 | 3.573 |
| Si@$SiO_x$-500th | 18.02 | 15.35 |
| SSL-500th | 9.322 | 10.71 |
| SiOC-1st | 35.39 | 3.541 |
| SSS-1st | 15.64 | 3.109 |

Table S3. $R_{ct}$ and $R_s$ values of SSL electrodes over 500 cycles.

| Number of cycles | Rct/Ω | Rs/Ω |
|---|---|---|
| After 1 cycle | 6.132 | 3.573 |
| After 10 cycles | 7.52 | 4.759 |
| After 20 cycles | 6.597 | 3.72 |
| After 50 cycles | 7.336 | 3.618 |
| After 100 cycles | 7.71 | 4.007 |
| After 200 cycles | 9.001 | 7.238 |
| After 500 cycles | 9.322 | 10.71 |

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