**Highly efficient cobalt sulfide heterostructures fabricated on nickel foam electrodes for enhanced oxygen evolution reaction in alkaline water electrolysis cells**

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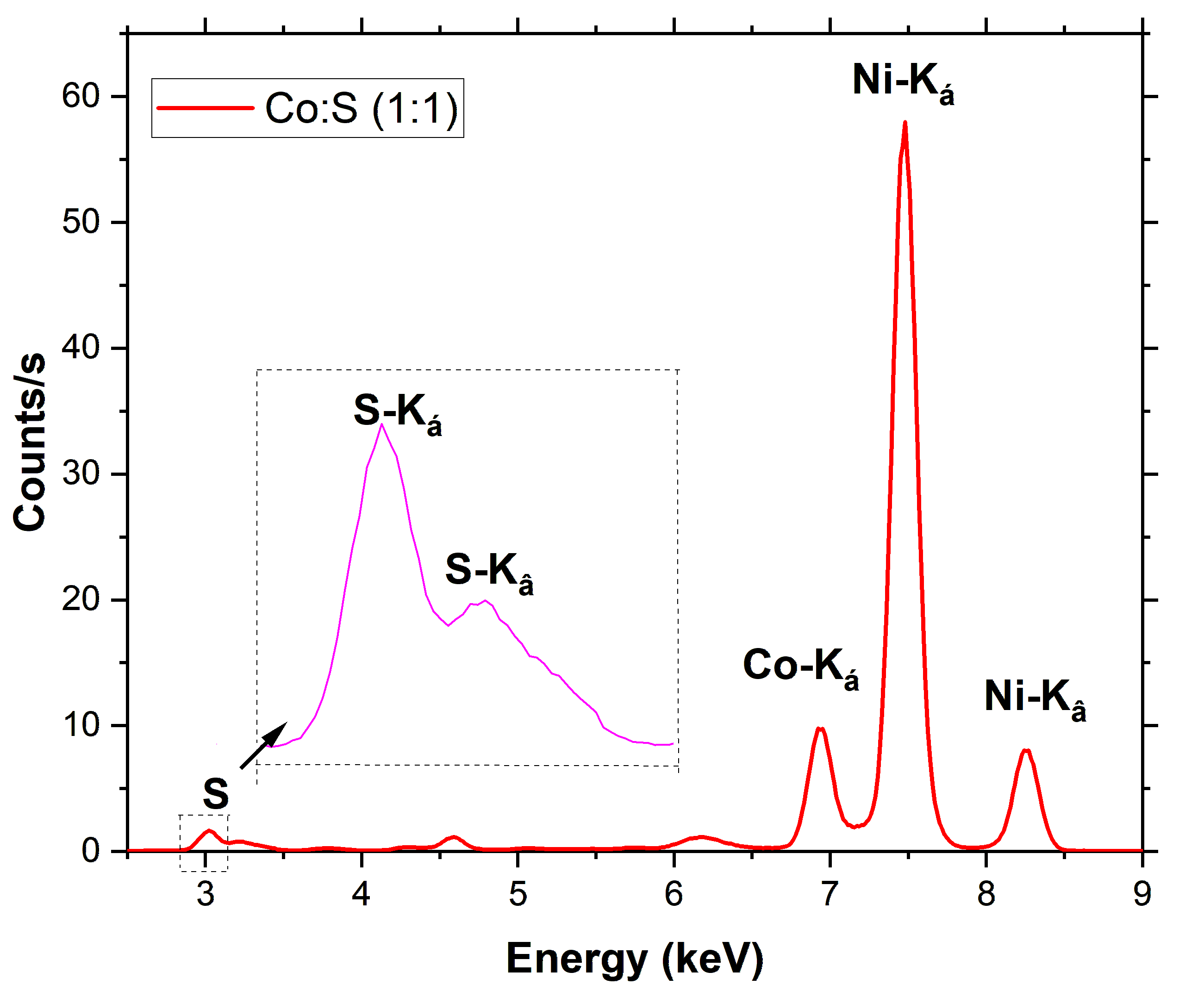
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**Supplementary material**

****Fig. S1. XRF analysis of the Co:S (1:1) electrode.

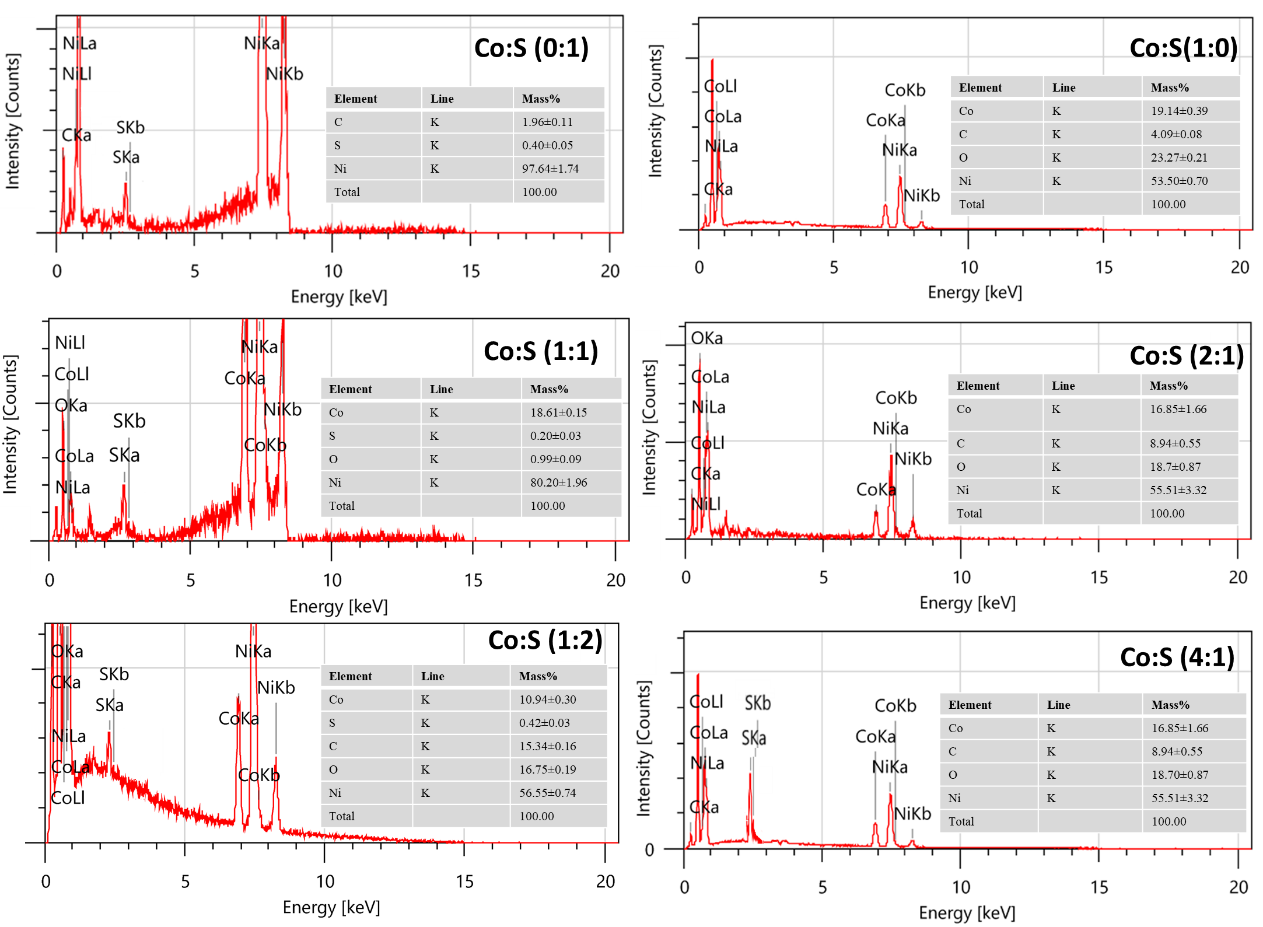


Fig. S2. EDS analysis of the as-prepared Co:S electrodes

Table S1. Lattice parameters of the as-prepared electrodes.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Electrode** | **λ (A)** | **Miller indices** | | | **Bragg’s angle** | | **d-spacing (A)** | **Lattice parameter (A)** | **Average lattice** |
|  | *1.5406* | *h* | *k* | *l* | *2θ* | *Θ* | *dhkl=λ/(2sinθ)* | *dhkl\*√(h2+k2+l2)* |  |
| **NF** | 1 | 1 | 1 | 45,27069 | 22,63535 | 2,001482 | 3,466669 | 3,44 |
| 2 | 0 | 0 | 54,50000 | 27,25000 | 1,682341 | 3,364682 |
| 2 | 2 | 0 | 77.02000 | 38,51000 | 1,237401 | 3,499897 |
|  |  |  |  |  |  |  |  |  |
| **Co:S (0:1)** | 1 | 0 | 2 | 44,76517 | 22,38259 | 2,022903 | 4,523349 | 3,50 |
| 1 | 1 | 0 | 52,10667 | 26,05334 | 1,753841 | 2,480305 |
| 2 | 0 | 2 | 76,51000 | 38,2505 | 1,244238 | 3,519236 |
|  |  |  |  |  |  |  |  |  |
| **Co:S (1:0)** | 4 | 0 | 0 | 44,77342 | 22,38671 | 2,022551 | 8,090199 | 7,16 |
| 4 | 4 | 0 | 52,13189 | 26,06595 | 1,753051 | 9,916755 |
| 2 | 0 | 2 | 77,17038 | 38,58519 | 1,235093 | 3,493371 |
|  |  |  |  |  |  |  |  |  |
| **Co:S (1:1)** | 4 | 0 | 0 | 44,8000 | 22,40000 | 2,021411 | 8,085646 | 7,17 |
| 4 | 4 | 0 | 52,1000 | 26,05000 | 1,754049 | 9,922424 |
| 2 | 0 | 2 | 76,5000 | 38,25000 | 1,244238 | 3,519236 |
|  |  |  |  |  |  |  |  |  |
| **Co:S (2:1)** | 4 | 0 | 0 | 44,8000 | 22,40000 | 2,021411 | 8,085646 | 7,17 |
| 4 | 4 | 0 | 52,06946 | 26,03473 | 1,755006 | 9,927813 |
| 2 | 0 | 2 | 76,58392 | 38,29196 | 1,243083 | 3,515971 |
|  |  |  |  |  |  |  |  |  |
| **Co:S (1:2)** | 4 | 0 | 0 | 44,75634 | 22,37817 | 2,023282 | 8,093127 | 7,17 |
| 4 | 4 | 0 | 52,09671 | 26,04836 | 1,754152 | 9,922983 |
| 2 | 0 | 2 | 76,50000 | 38,25000 | 1,244238 | 3,519236 |
|  |  |  |  |  |  |  |  |  |
| **Co:S (4:1)** | 4 | 0 | 0 | 44,78251 | 22,39126 | 2,022161 | 8,088641 | 7,17 |
| 4 | 4 | 0 | 52,12334 | 26,06167 | 1,753319 | 9,918267 |
| 2 | 0 | 2 | 76,50000 | 38,25001 | 1,244238 | 3,519236 |

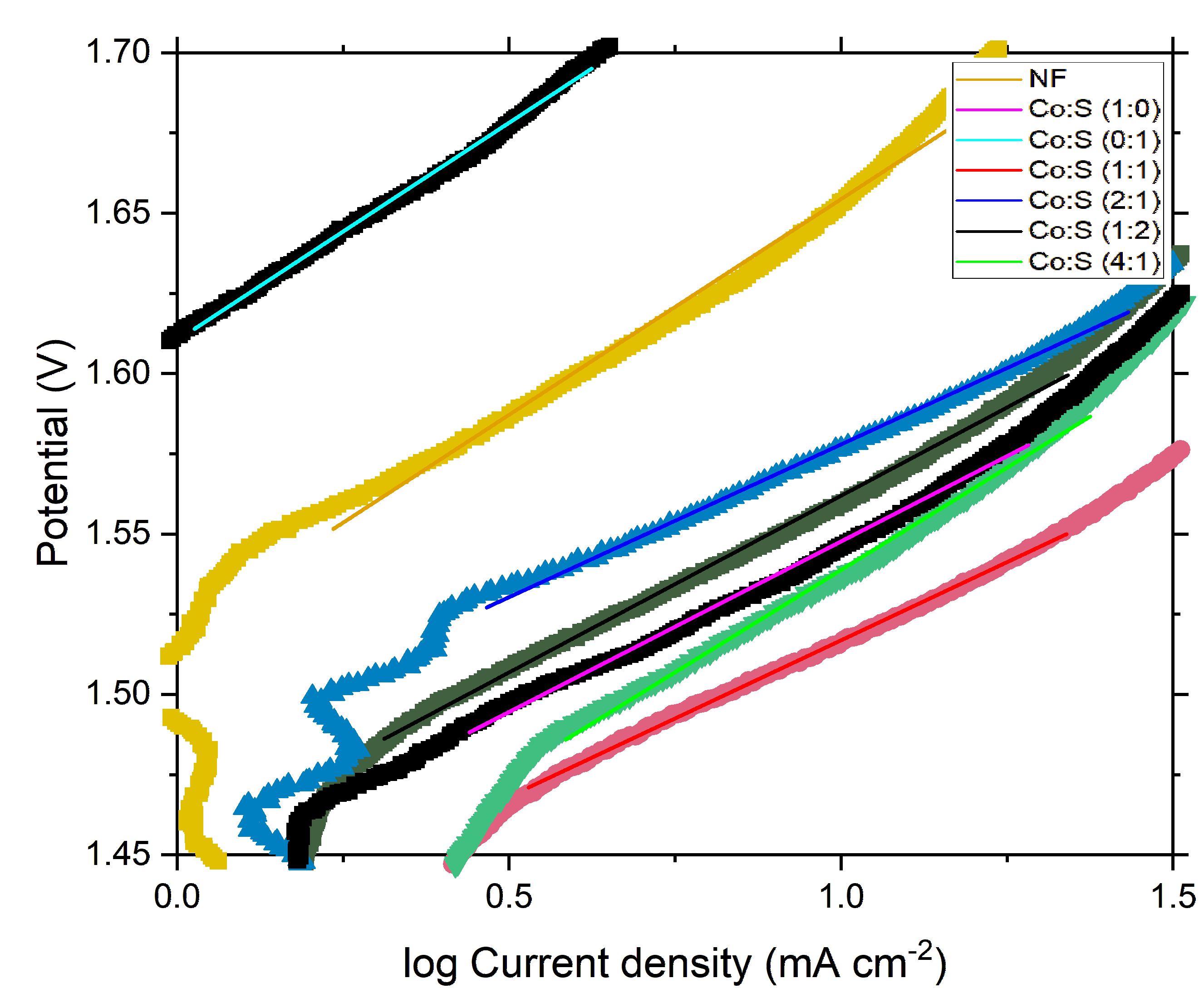


Fig. S3. Tafel slope of the fabricated electrodes in 1M KOH electrolyte.

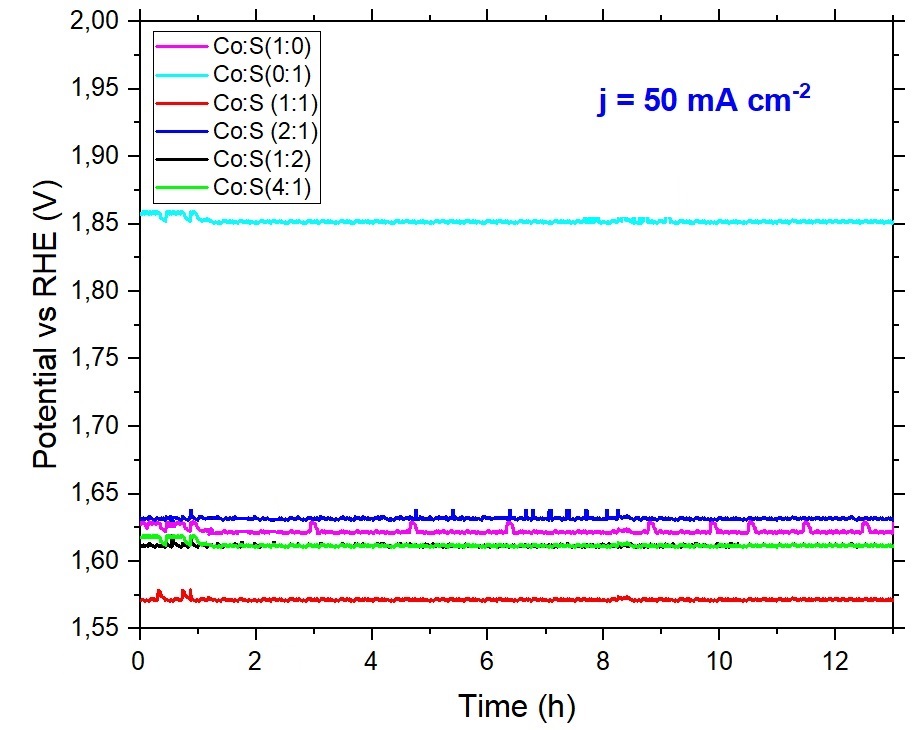


Fig. S4. Stability test of all the fabricated electrodes at 50mA cm-2 current density in 30%wt. KOH.

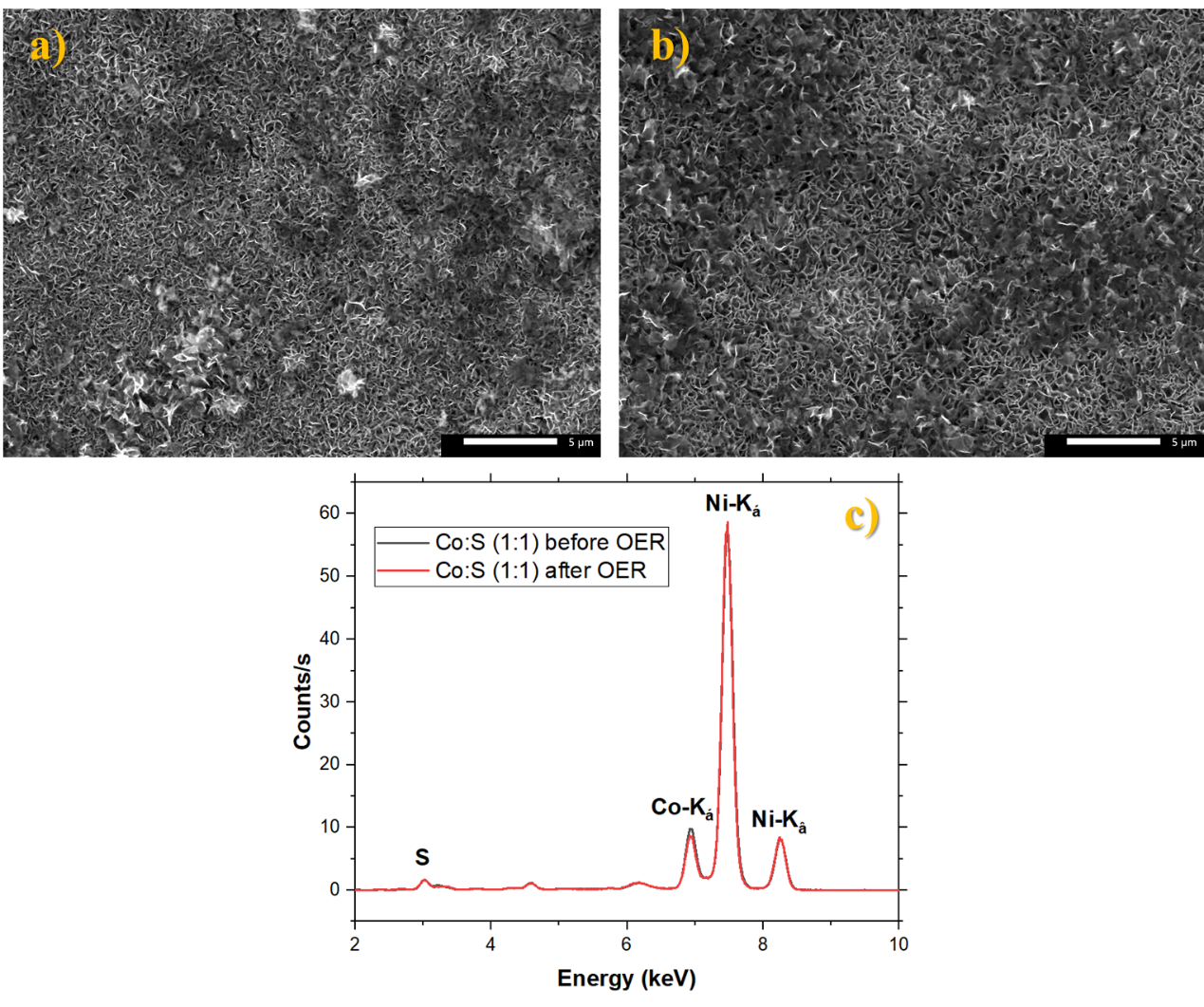


Fig. S5 FE-SEM of the Co:S (1:1) before (a) and after prolonged stability test (b). XRF spectra of the Co:S (1:1) electrode before and after the OER stability test.

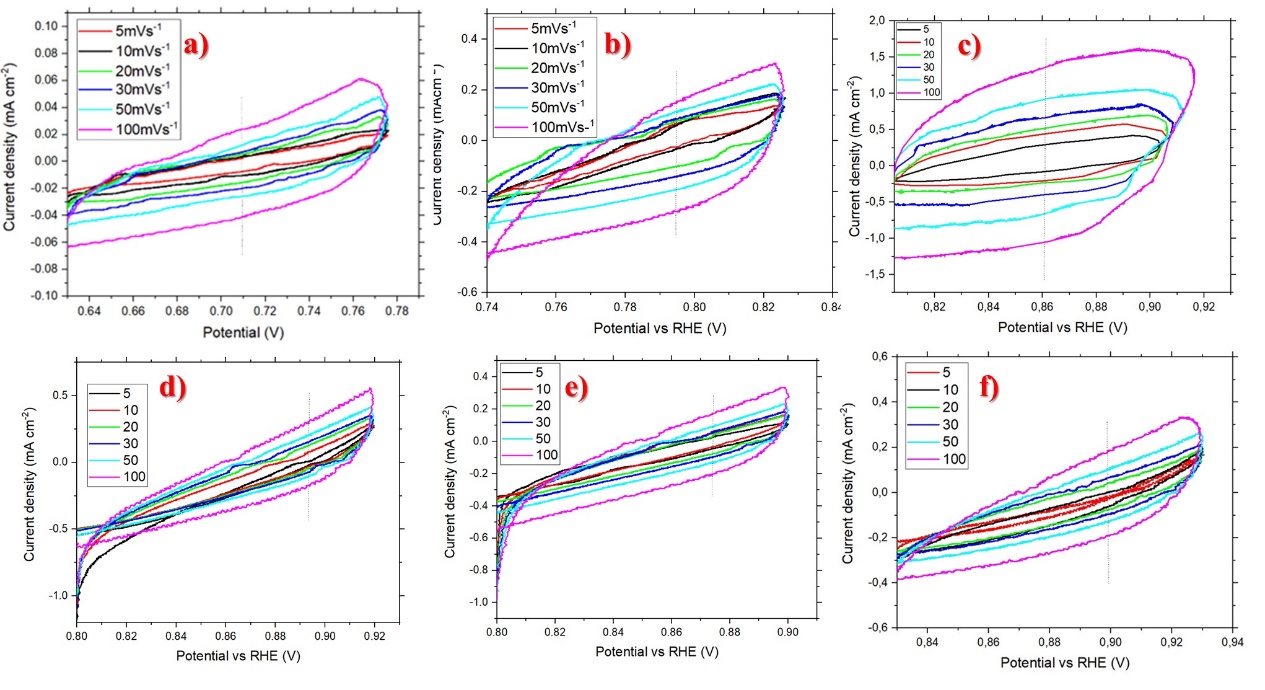


Fig. S6. Capacitance double layer measurements with cyclic voltammetry for the Co:S (0:1) (a), Co:S (1:0) (b) Co:S (1:1) (c), Co:S (2:1) (d), Co:S (1:2) (e), and Co:S (4:1) (f) electrodes in 1M KOH

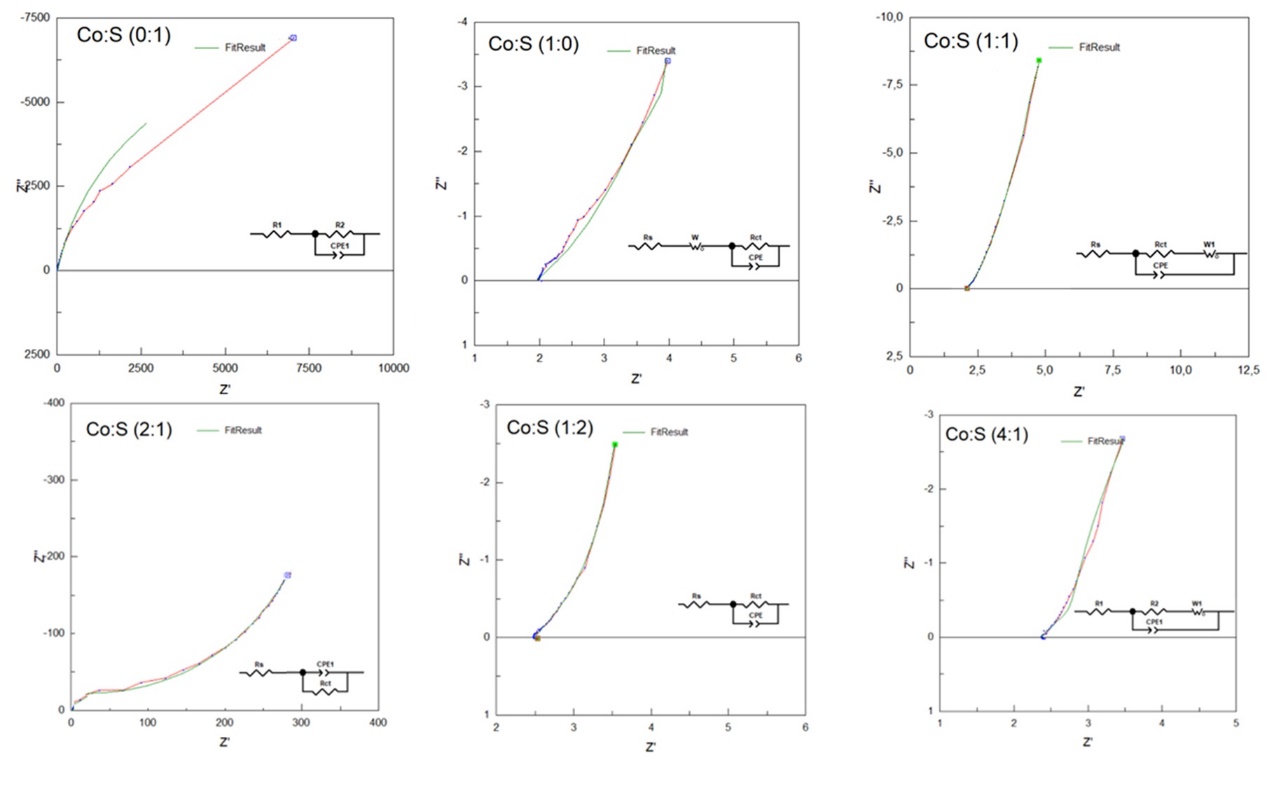


Fig. S7. Eis fitting data and equivalent circuits obtained from Zview software for the as-prepared electrodes