This supplementary material consists of the following:

1. Optical micrograph of carbon steel sample
2. OCP measurement of carbon steel in 3.75 M NH4Cl solution containing Na2S2O3 of varied concentrations
3. FESEM micrographs of carbon steel after immersion in pure 1 M S2O32- solution for 12 hours
4. EDS analysis inside the pit, formed on the carbon steel surface after immersion in 3.75 M NH4Cl solution containing 1 M S2O32-**,** for a period of 72 hours
5. The impedance data is validated with KKT and the results are shown below. It clearly shows that the transformed data maps well with the experimental data
6. FESEM micrographs of (a) pure 3.75 M NH4Cl (b) 3.75 M NH4Cl + 0.01 M S2O32- (c) 3.75 M NH4Cl + 0.1 M S2O32- and (d) 3.75 M NH4Cl + 1 M S2O32- solutions, corresponding to EDS spectra presented in Figure 9
7. pH values of electrolyte media for various Cl-:S2O32- ratio

**Figure S1**: Optical micrograph of carbon steel sample

****

**Figure S2**: OCP measurement of carbon steel in 3.75 M NH4Cl solution containing Na2S2O3 of varied concentration



**Figure S3**: FESEM micrographs of carbon steel after immersion in pure 1 M S2O32- solution for 12 hours



**Figure S4:** EDS analysis inside the pit, formed on the carbon steel surface after immersion in 3.75 M NH4Cl solution containing 1 M S2O32-for a period of 72 hours

|  |
| --- |
|  |
|  |

**Figure S5**: KKT impedance vs. frequency plots along with experimental values for: (a) pure 3.75 M NH4Cl, (b) 3.75 M NH4Cl + 0.01 M S2O32- solution, (c) 3.75 M NH4Cl + 0.1 M S2O32- solution, and (d) 3.75 M NH4Cl + 1 M S2O32-

|  |  |
| --- | --- |
|  |  |
|  **(a)** |  **(b)** |
|  |  |
|  **(c)** |  **(d)** |

|  |  |
| --- | --- |
|  |  |
|  |  |

**Figure S6:** FESEM micrographs of (a) pure 3.75 M NH4Cl (b) 3.75 M NH4Cl + 0.01 M S2O32- (c) 3.75 M NH4Cl + 0.1 M S2O32- and (d) 3.75 M NH4Cl + 1 M S2O32- solutions, corresponding to EDS spectra presented in Figure 9

**Table S1:** pH values of electrolyte media for various Cl-:S2O32- ratio

|  |  |
| --- | --- |
| **Electrolyte media** | **pH** |
| Cl-:S2O32- = 1:0.13 | 6.17 |
| Cl-:S2O32- = 1:0.26 | 6.46 |
| Cl-:S2O32- = 1:0.53 | 6.76 |
| Cl-:S2O32- = 1:1 | 6.99 |
| Cl-:S2O32- = 1:1.33 | 7.13 |