**Supplementary information**

**EDS Spot Analysis**

**Table S1**. Elemental composition (at%), determined by EDS spot analysis, across the cross section of AISI 430 H2-H2O. The numbers indicate corresponding spots in Fig. 3 (b).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Elements** | **1** | **2** | **3** | **4** | **5** |
| **O** | 0 | 26 ± 2 | 38 ± 3 | 41 ± 2 | 55 ± 1 |
| **Si** | 0 | 8 ± 2 | 2 ± 2 | 0 | 0 |
| **Cr** | 67 ± 1 | 36 ± 5 | 36 ± 4 | 25 ± 2 | 0 |
| **Mn** | 1 ± 1 | 3 ± 2 | 8 ± 0 | 0 | 0 |
| **Fe** | 33 ± 0 | 28 ± 6 | 22 ± 4 | 34 ± 1 | 45 ± 1 |
| **Possible compounds** | FeCr2 | SiO2 | (Mn,Fe,Cr)xO4 | FeCrO4 | FeOx |

**Table S2**. Elemental composition (at%), determined by EDS spot analysis, across the cross section of Ni coated AISI 430 in Ar - 3%H2- 3%H2O. The numbers indicate corresponding spots in Fig. 6 (c).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Elements** | **1** | **2** | **3** | **4** | **5** |
| **O** | 23 ± 5 | 39 ± 2 | 4 ± 1 | 47 ± 2 | 9 ± 7 |
| **Si** | 13 ± 3 | 2 ± 1 | 0 | 2 ± 1 | 1 ± 0 |
| **Cr** | 10 ± 1 | 28 ± 2 | 11 ± 1 | 35 ± 3 | 5 ± 3 |
| **Mn** | 1 ± 0 | 7 ± 1 | 0 | 1 ± 0 | 0 |
| **Fe** | 47 ± 6 | 16 ± 3 | 56 ± 2 | 11 ± 3 | 44 ± 8 |
| **Ni** | 7 ± 2 | 3 ± 1 | 29 ± 3 | 5 ± 2 | 42 ± 3 |
| **Possible compounds** |  | MnCr2O4 |  | CrO | FeNi |

**Table S3**. Elemental composition (at%), determined by EDS spot analysis, across the cross section of Ni-P coated AISI 430 in Ar - 3%H2. The numbers indicate corresponding spots in Fig. 8 (b).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Elements** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **O** | 4 ± 0 | 45 ± 2 | 49 ± 2 | 5 ± 3 | 48 ± 3 | 50 ± 8 | 37 ± 3 |
| **Si** | 0 | 1 ± 1 | 0 | 0 | 0 | 1 ± 1 | 0 |
| **P** | 26 ± 0 | 0 | 0 | 1 ± 1 | 1 ± 0 | 13 ± 4 | 0 |
| **Cr** | 25 ± 0 | 35 ± 8 | 33 ± 4 | 3 ± 2 | 24 ± 4 | 3 ± 3 | 12 ± 4 |
| **Mn** | 1 ± 0 | 0 | 2 ± 1 | 0 | 0 | 0 | 0 |
| **Fe** | 37 ± 1 | 14 ± 5 | 12 ± 4 | 55 ± 3 | 18 ± 1 | 21 ± 5 | 10 ± 2 |
| **Ni** | 7 ± 1 | 5 ± 2 | 3 ± 1 | 35 ± 3 | 8 ± 8 | 11 ± 13 | 40 ± 9 |
| **Possible compounds** |  | Cr2O3 | Cr2O3  /MnCr2O4 |  | Cr2O3 | Fe-P-O | Cr2O3 |

**Table S4**. Elemental composition (at%), determined by EDS spot analysis, across the cross section of Ni-P coated AISI 430 in Ar - 3%H2 – 3%H2O. The numbers indicate corresponding spots in Fig. 9 (b).

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Elements** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **O** | 0 | 37 ± 1 | 0 | 37 ± 2 | 0 | 46 ± 4 | 41 ± 2 | 51 ± 1 | 44 ± 3 |
| **Si** | 1 ± 0 | 1 ± 0 | 9 ± 3 | 0 | 0 | 0 | 0 |  |  |
| **P** | 28 ± 4 | 0 | 0 | 0 | 0 | 17 ± 2 | 4± 1 |  |  |
| **Cr** | 26 ± 4 | 50 ± 7 | 5 ± 0 | 39 ± 4 | 7 ± 2 | 6 ± 3 | 22 ± 2 |  | 1 ± 0 |
| **Mn** | 1 ± 0 | 5 ± 1 | 0 | 0 | 0 | 3 ± 0 | 0 |  |  |
| **Fe** | 38 ± 7 | 6 ± 5 | 57 ± 8 | 21 ± 2 | 45 ± 0 | 28 ± 2 | 33 ± 2 | 47 ± 2 | 56 ± 2 |
| **Ni** | 6 ± 2 | 3 ± 4 | 29 ± 7 | 6 ± 1 | 47 ± 2 |  | 1 ± 0 |  |  |
| **Possible compounds** | CrP. | Cr2O3,  Mn-Cr-O |  | Cr2O3 |  | Fe-P-O. Fe-Cr-O | Fe-Cr-O; | Fe3O4-x | Fe1+xO |