Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.


# Supporting Information

## Ball-Milled Sulfur-Doped Graphene Materials Contain Metallic Impurities Originating from Ball-Milling Apparatus: Influence on the Catalytic Properties

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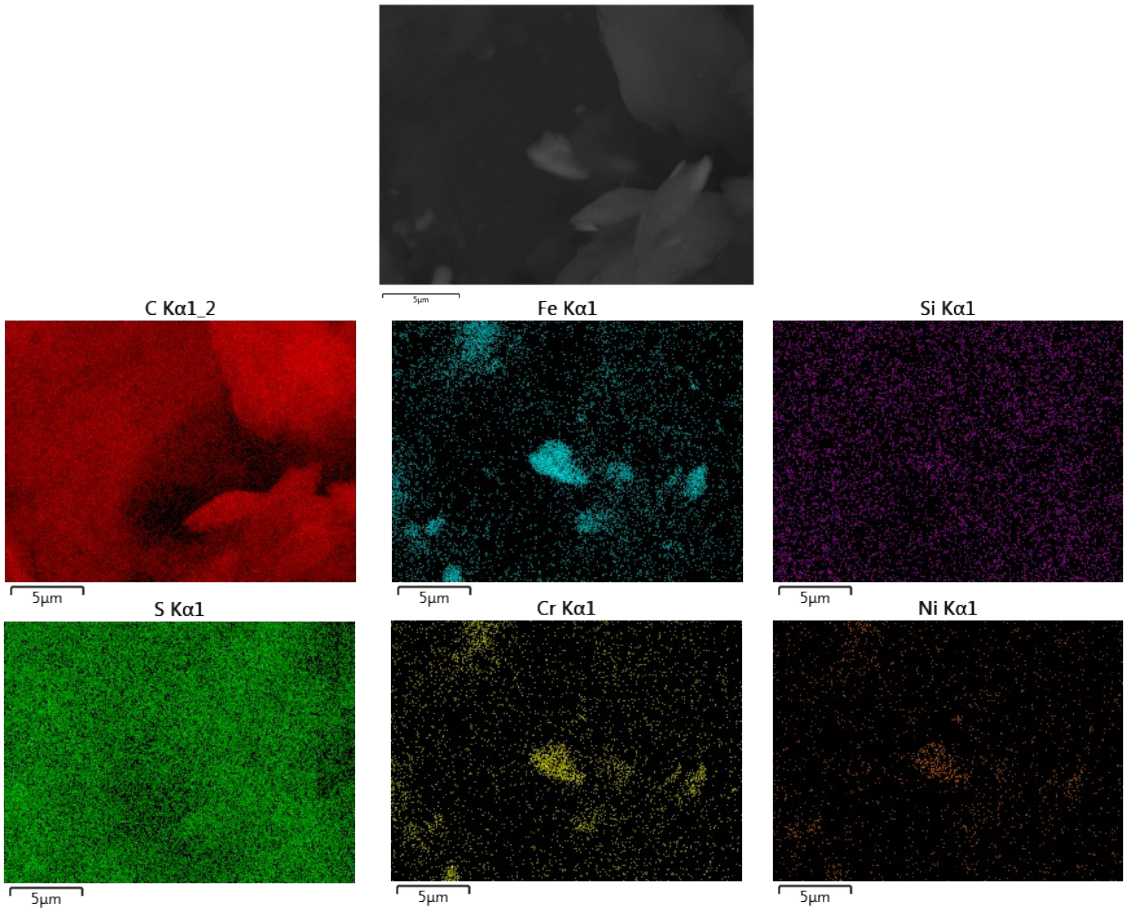


**Figure S1.** EDS analysis of BMG-SS showing the presence of C, Fe, Si, S, Cr and Ni elements.

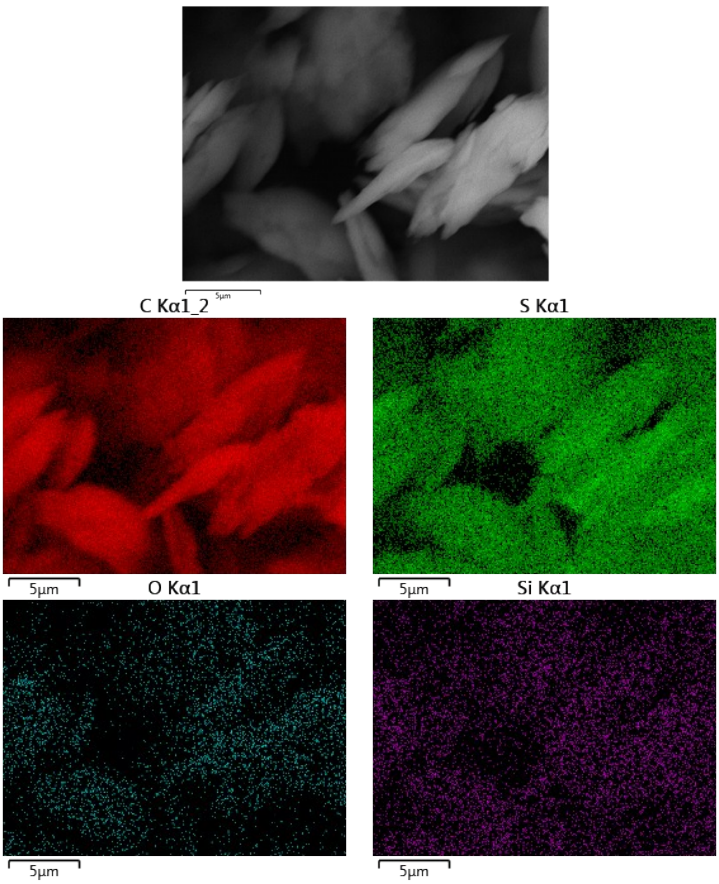


**Figure S2.** EDS analysis of BMG-ZO showing the presence of C, S, O and Si elements.

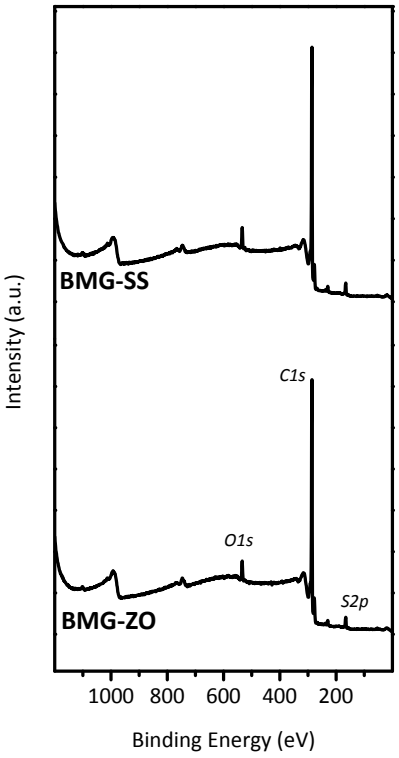


**Figure S3.** Survey XPS of BMG-SS and BMG-ZO.

**Table S1.** Elemental composition of BMG-SS and BMG-ZO based on XPS survey scans and combustible elemental analysis.

| | Elemental concentration from XPS survey scan (at%) | | |
|---|---|---|---|
| **Material** | **C** | **O** | **S** |
| **BMG-SS** | 93.39 | 3.47 | 3.14 |
| **BMG-ZO** | 93.67 | 3.34 | 2.99 |

| | Elemental concentration from combustible elemental analysis (at%) | | | |
|---|---|---|---|---|
| **Material** | **C** | **O** | **S** | **H** |
| **BMG-SS** | 87.55 | 7.70 | 2.27 | 2.48 |
| **BMG-ZO** | 96.02 | 1.06 | 1.88 | 1.04 |

**Table S2.** Composition distribution of sulfur groups in BMG-SS and BMG-ZO.

| | Elemental concentration from XPS survey scan (at%) | | |
|---|---|---|---|
| **Material** | **H-S-C** | **R-S-C** | **S-O** |
| **BMG-SS** | 70.76 | 13.75 | 15.49 |
| **BMG-ZO** | 80.34 | 11.72 | 7.94 |

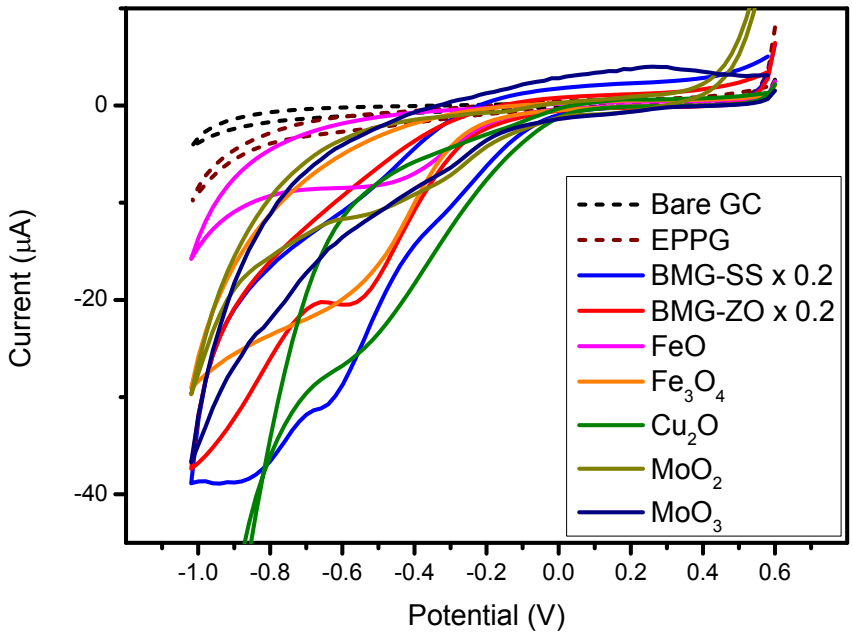


**Figure S4.** Cyclic voltammograms for 10 mM CHP on bare GC, EPPF, BMG-SS, BMG-ZO, FeO-, $Fe_3O_4$-, $Cu_2O$-, $MoO_2$- and $MoO_3$-modified electrodes. The suffix × denotes the number of times the current values of the cyclic voltammograms were scaled for ease of comparison. Supporting electrolyte, 50 mM phosphate buffered solution at pH 7.2. Purged with $N_2$. Scan rate 100 mV $s^{-1}$. Reference electrode, Ag/AgCl.

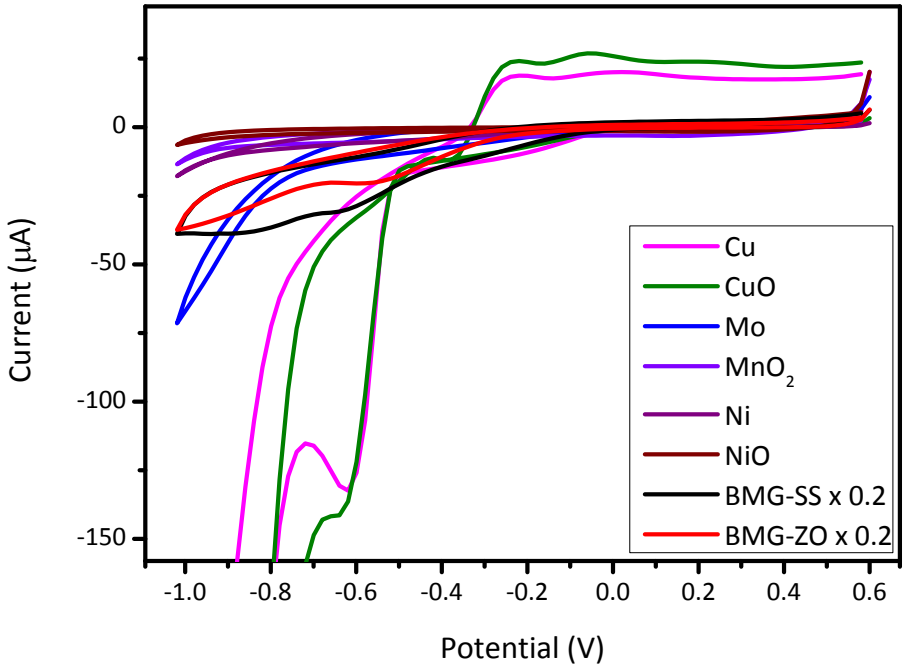


**Figure S5.** Cyclic voltammograms for 10 mM CHP on Cu-, CuO-, Mo-, $MnO_2$-, Ni- and NiO-modified electrodes as well as on BMG-SS and BMG-ZO. Supporting electrolyte, 50 mM phosphate buffered solution at pH 7.2. Purged with $N_2$. Scan rate 100 mV $s^{-1}$. Reference electrode, Ag/AgCl. The peak potential observed on Cu and CuO are not catalytic reduction peak of CHP since they overlap wholly with their inherent reduction peaks.

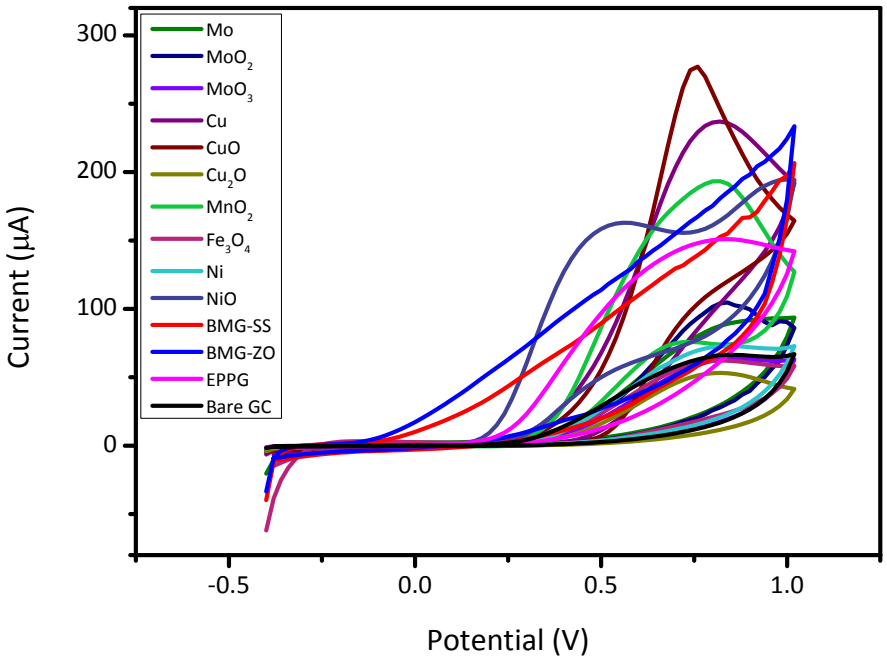


**Figure S6.** Cyclic voltammograms for 5 mM $N_2H_4$ on bare GC, EPPG, BMG-SS-, BMG-ZO-, Mo-, $MoO_2$-, $MoO_3$-, Cu-, CuO-, $Cu_2O$-, $MnO_2$-, $Fe_3O_4$-, Ni- and NiO-modified electrodes (solid lines), as well as the respective blank measurements (dotted lines). Supporting electrolyte, 50 mM phosphate buffered solution at pH 7.2. Purged with $N_2$. Scan rate 100 mV $s^{-1}$. Reference electrode, Ag/AgCl.