

Experimental and theoretical investigation of the chemical exfoliation of Cr-based MAX phase particles

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Supplementary Information

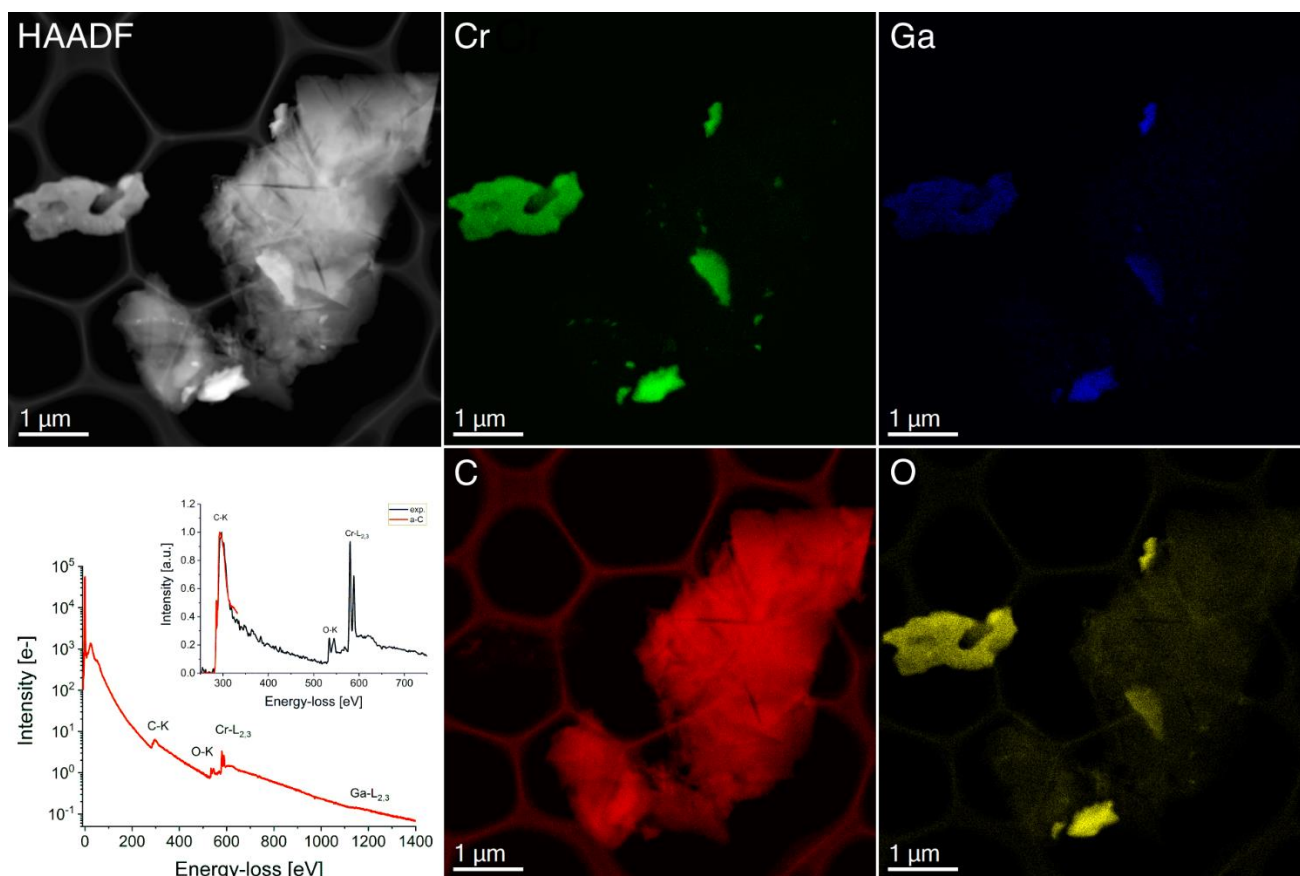


Figure SI-1: STEM-EDX elemental mapping of chromium oxide particles embedded in amorphous carbon and a wide range STEM-EELS measurement (lower left graph) of a single chromium oxide particle.

Table SI-1: Quantitative analysis of a STEM-EELS measurement of a single α -Cr₂O₃ particle.

| Element | Composition [at%] | Nominal composition [at%] |
|---------|-------------------|---------------------------|
| O | 65 | 60 |
| Cr | 35 | 40 |

Figure SI-1 shows a STEM-EDX mapping of several α -Cr₂O₃ particles surrounded by amorphous carbon, which is believed to be a residue of the exfoliation or TEM sample preparation process. The STEM-HAADF

image shows a bright contrast for the α -Cr₂O₃ particles due to their larger average Z value. The elemental maps of Cr and O show exactly at these locations an elemental signal. The Ga map reveals that the α -Cr₂O₃ particles also contain residual amounts of Ga (about 1-2 at%). The wide range STEM-EELS spectrum (see EELS graph on lower left of Figure SI-1) reveals that C, O, Cr, and Ga are present. The C is due to the amorphous surrounding, whereas Cr, O, and Ga are forming the particles. Table SI-1 reveals that the measured Cr and O contents are close to the nominal ones. The slight excess in O might be due to surrounding C, which can also contain a few at% of O. Inspecting the electron near edge fine-structure (ELNES) of O (see inset in EELS graph on lower left of Figure SI-1) one recognizes that it fits well to that of α -Cr₂O₃.

The STEM-EDX line profile shown in Figure SI-2 confirms the finding from the mapping in Figure 4 of the original manuscript that an almost perfect Cr:C ratio of 60:40 is detected.

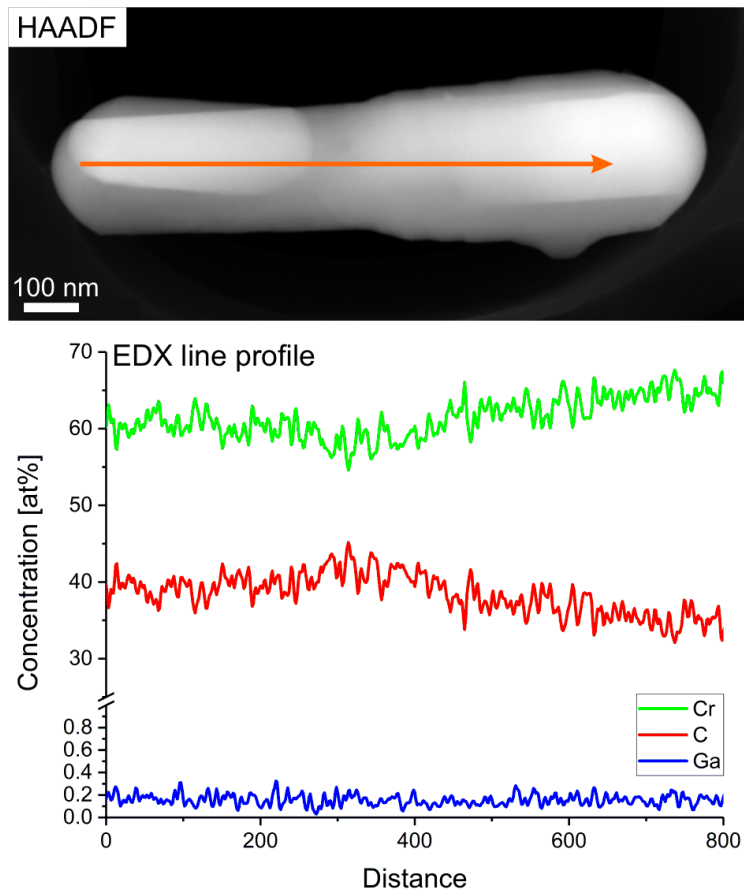


Figure SI-2: STEM-EDX line profile carried out across the particle analyzed in Figure 4 of the manuscript.

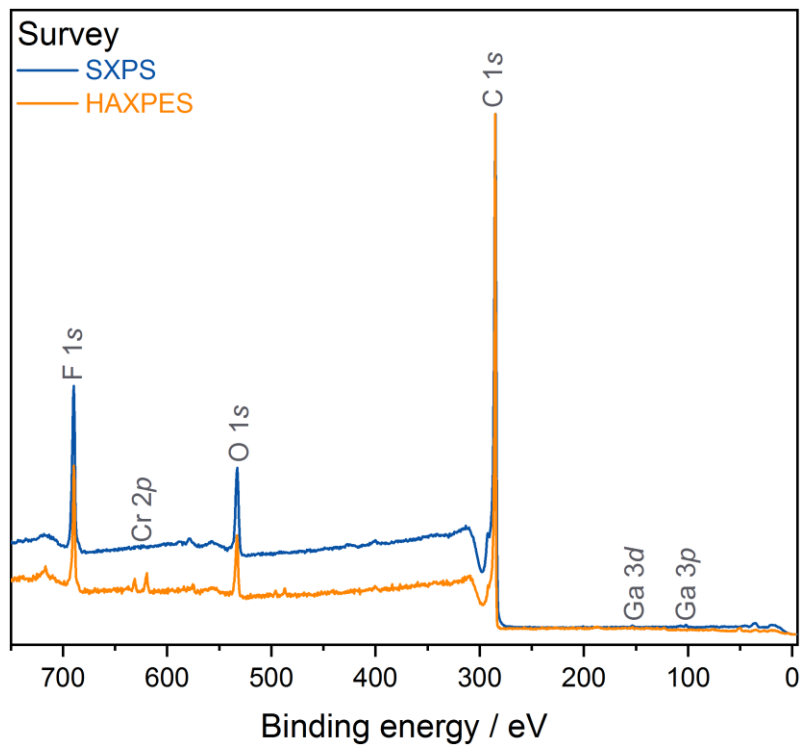


Figure SI-3: Survey SXPS and HAXPES spectra of the HF-treated sample.