

## **Supporting Information**

### **Efficient Extraction of Slow-releasing Cr(VI) from Nano-sized Ion Channels in Cr(VI)–Ettringite from Reduced Chromite Ore Processing Residue**

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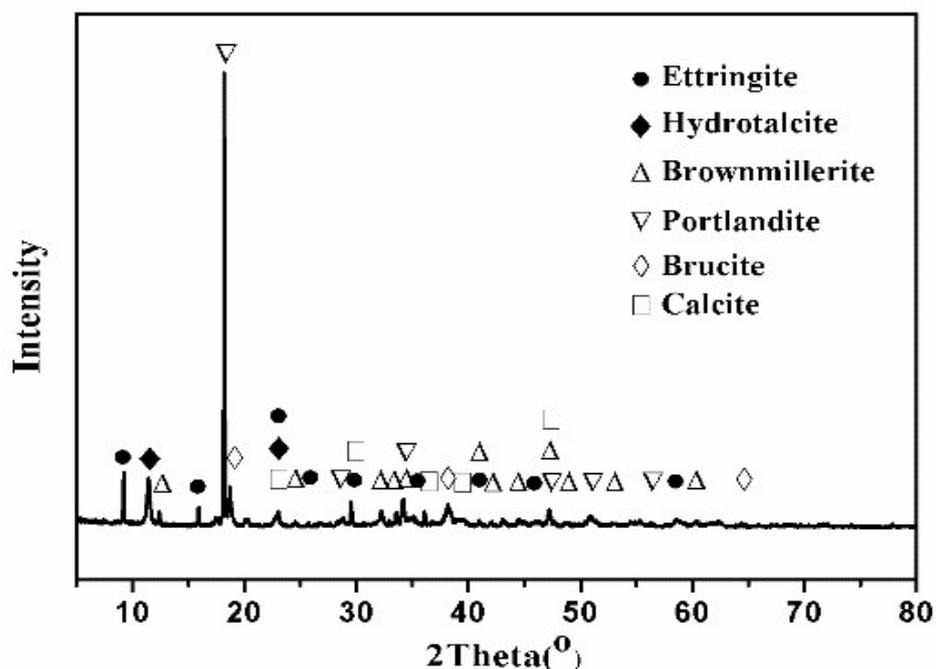
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**Table S1.** The content of main elements in the pristine rCOPR was tested by XRF.

	Cr	Ca	Mg	Al	Fe	Na	S	Ref.
rCOPR	8.9	39.2	24.8	5.9	13.5	0.075	2.0	this work
Lime-based COPR-1	1.8	23.7	13.8	4.4	5.1	2.2	1.1	[1]
Lime-based COPR-2	2.33	20.6	4.6	5.5	12.5	\	\	[2]



**Figure S1.** XRD pattern of the pristine rCOPR.[3]

Ettringite:  $\text{Ca}_6\text{Al}_2(\text{SO}_4)_3(\text{OH})_{12}\cdot 26\text{H}_2\text{O}$  (pdf:00-041-1451)

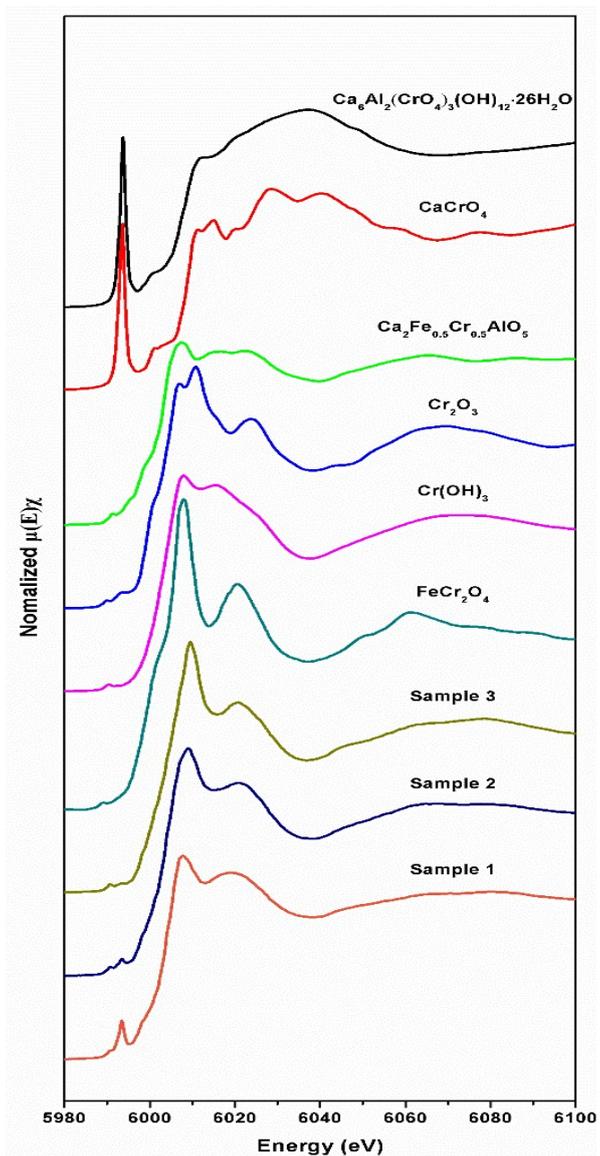
Hydrotalcite:  $\text{Mg}_6\text{Al}_2\text{CO}_3(\text{OH})_{16}\cdot 4\text{H}_2\text{O}$  (pdf:01-087-1138)

Brownmillerite:  $\text{Ca}_2\text{FeAlO}_5$  (pdf:01-070-2764)

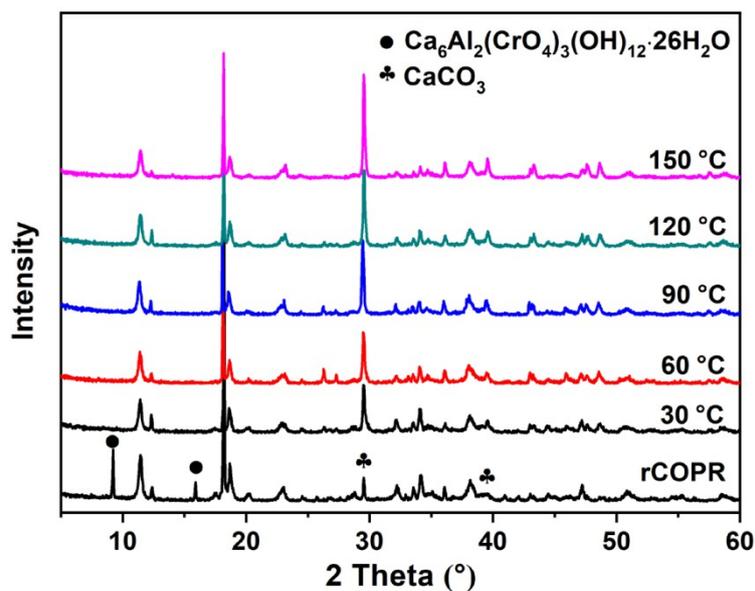
Portlandite:  $\text{Ca}(\text{OH})_2$  (pdf:01-084-1264 )

Brucite:  $\text{Mg}(\text{OH})_2$  (pdf:01-084-2164)

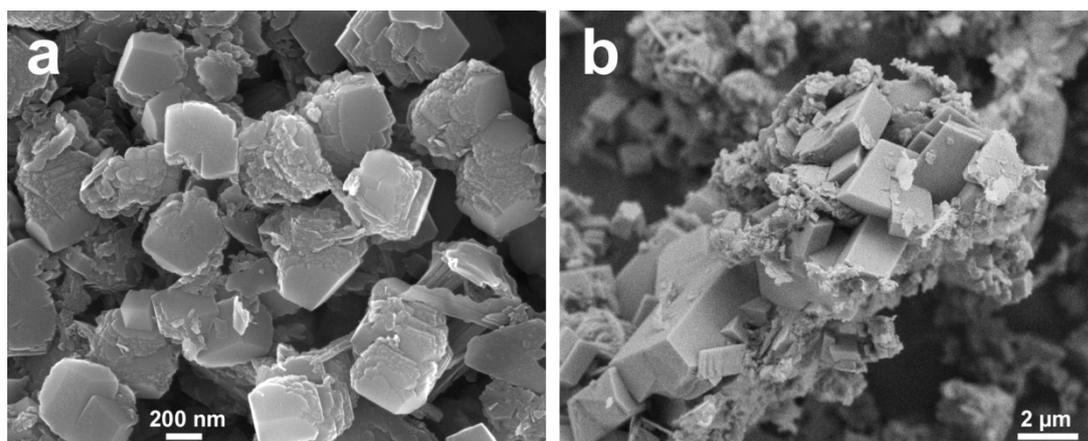
Calcite:  $\text{CaCO}_3$  (pdf:01-072-1651)



**Figure S2.** Cr *K*-edge XAFS spectra of the samples and reference compounds. Sample 1, 2, 3 refer to the pristine COPR, the treated COPR by using 1M  $\text{NaHCO}_3$  under room temperature, and the treated COPR by using 1 M  $\text{NaHCO}_3$  under hydrothermal conditions, respectively.



**Figure S3.** a) XRD pattern of the treated COPR with different hydrothermal temperature from 30-150 °C (1 M NaHCO<sub>3</sub>, hydrothermal time = 3 h.)



**Figure S4.** SEM images of CaCO<sub>3</sub> in treated COPR with 1M NaHCO<sub>3</sub>: a) without hydrothermal treatment. b) with hydrothermal treatment at 120 °C for 3 h.

**Table S2.** The pH of solution as a function of NaHCO<sub>3</sub> concentration.

NaHCO <sub>3</sub> concentration (mol/L)	0.05	0.1	0.2	0.5	1	2
pH	12.09	12.47	10.60	10.09	9.89	9.74

**Table S3.** The pH of the solution as a function of hydrothermal temperature and hydrothermal time.

Hydrothermal temperature (°C)	30	60	90	120	150
pH	9.89	9.64	9.55	9.61	9.78
Hydrothermal time (h)	0.5	1	2	3	4
pH	9.46	9.49	9.53	9.61	9.82

## References

- [1] X. Wang, J. Zhang, L. Wang, J. Chen, H. Hou and J. Yang, Long-term stability of FeSO<sub>4</sub> and H<sub>2</sub>SO<sub>4</sub> treated chromite ore processing residue (COPR): Importance of H<sup>+</sup> and SO<sub>4</sub><sup>2-</sup>. *J. Hazard Mater.*, 2017, **321**, 720-727.
- [2] M. Chrysochoou, S. C. Fakra, M. A. Marcus, D. H. Moon and D. Dermatas, Microstructural Analyses of Cr(VI) Speciation in Chromite Ore Processing Residue (COPR). *Environ Sci Technol*, 2009, **43**, 5461-5466.
- [3] Y. Song, J. Li, M. Peng, Z. Deng, J. Yang and W. Liu, Identification of Cr(VI) speciation in ferrous sulfate-reduced chromite ore processing residue (rCOPR) and impacts of environmental factors erosion on Cr(VI) leaching. *J. Hazard Mater.*, 2019, **373**, 389-396.