Supporting Information

Three-Dimensional Morphology Control During Wet Chemical Synthesis of Porous Chromium Oxide Spheres

Lifang Chen, Zhi Song,[‡] Xue Wang,[†] Sergey V. Prikhodko,[§] Juncheng Hu,[‡,] Suneel Kodambaka[§] and Ryan Richards[†,*]*

Department of Chemistry and Geochemistry, Colorado School of Mines, Golden, CO 80401, USA, and Key Laboratory of Catalysis and Materials Science of Hubei Province, South-Central University for Nationalities, Wuhan, 430074, China, and Department of Materials Science and Engineering, University of California Los Angeles, Los Angeles, CA 90095, USA

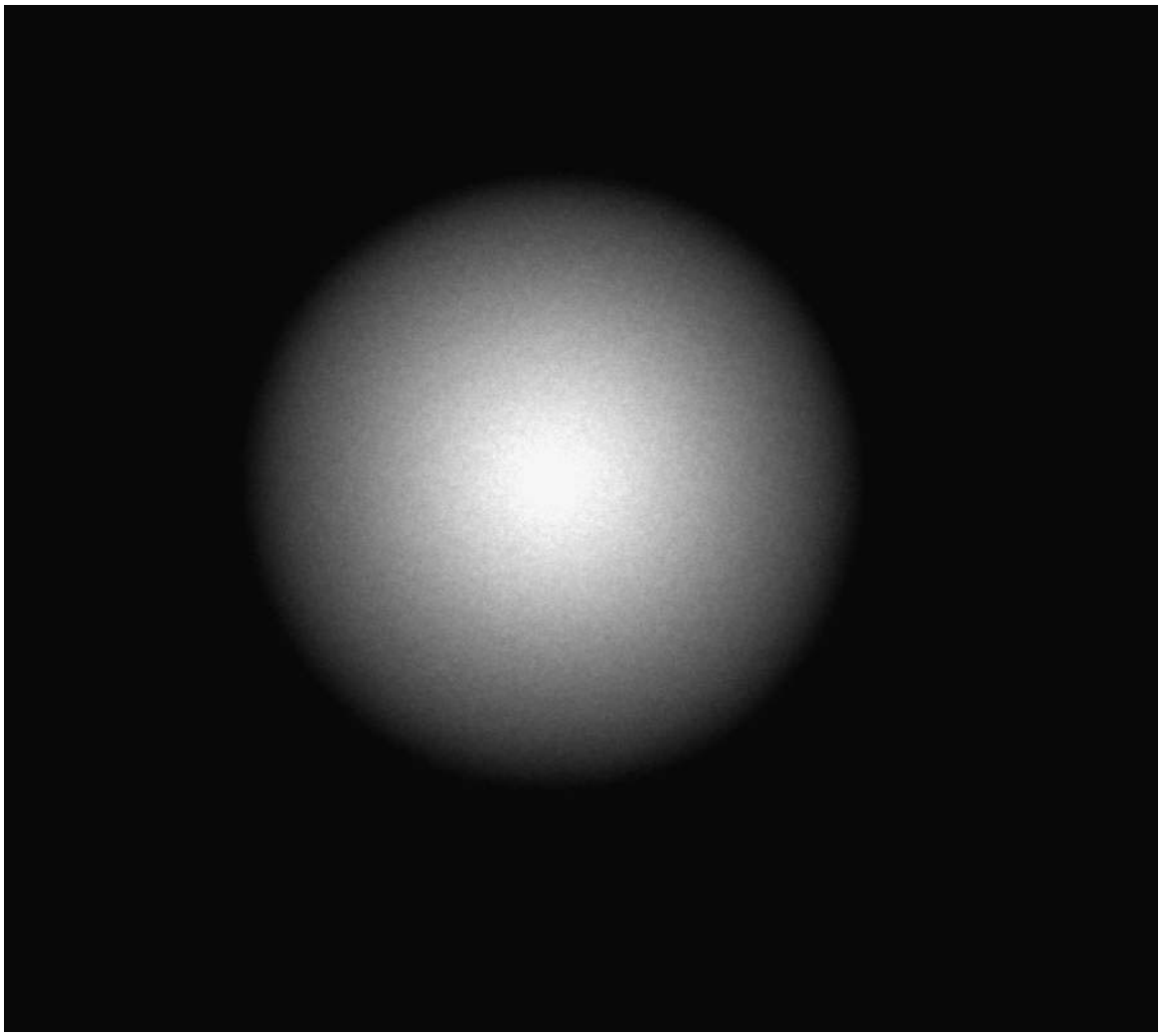

Figure S1. Selected area electron diffraction (SAED) pattern of an individual as-synthesized chromium oxide precursor.

Table S1. List of measured (dm) interplanar spacing values for porous chromium oxide spheres in comparison with JCPDS values (dt) shown along with the corresponding planes. It was synthesized from 0.025 M chromium nitrate solution and calcined at 500 ^{o}C for 4 h.

d [Å] (m)	D [Å] (t)	Indexing (hkl)	Error, %
3.605	3.62	102	0.4
2.7037	2.67	014	1.24
2.5006	2.47	110	1.22
2.163	2.17	113	0.32
1.7876	1.81	204	1.23
1.6638	1.67	116	0.37

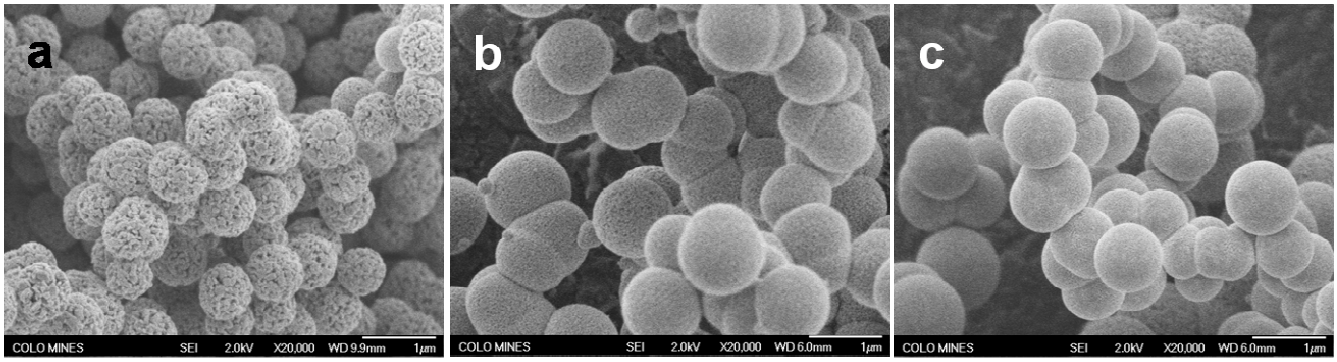

Figure S2. SEM images of porous chromium oxide spheres prepared by constant chromium nitrate concentration 0.025 M and different urea concentrations 0 M a), 0.05 M b), and 0.15 M c).

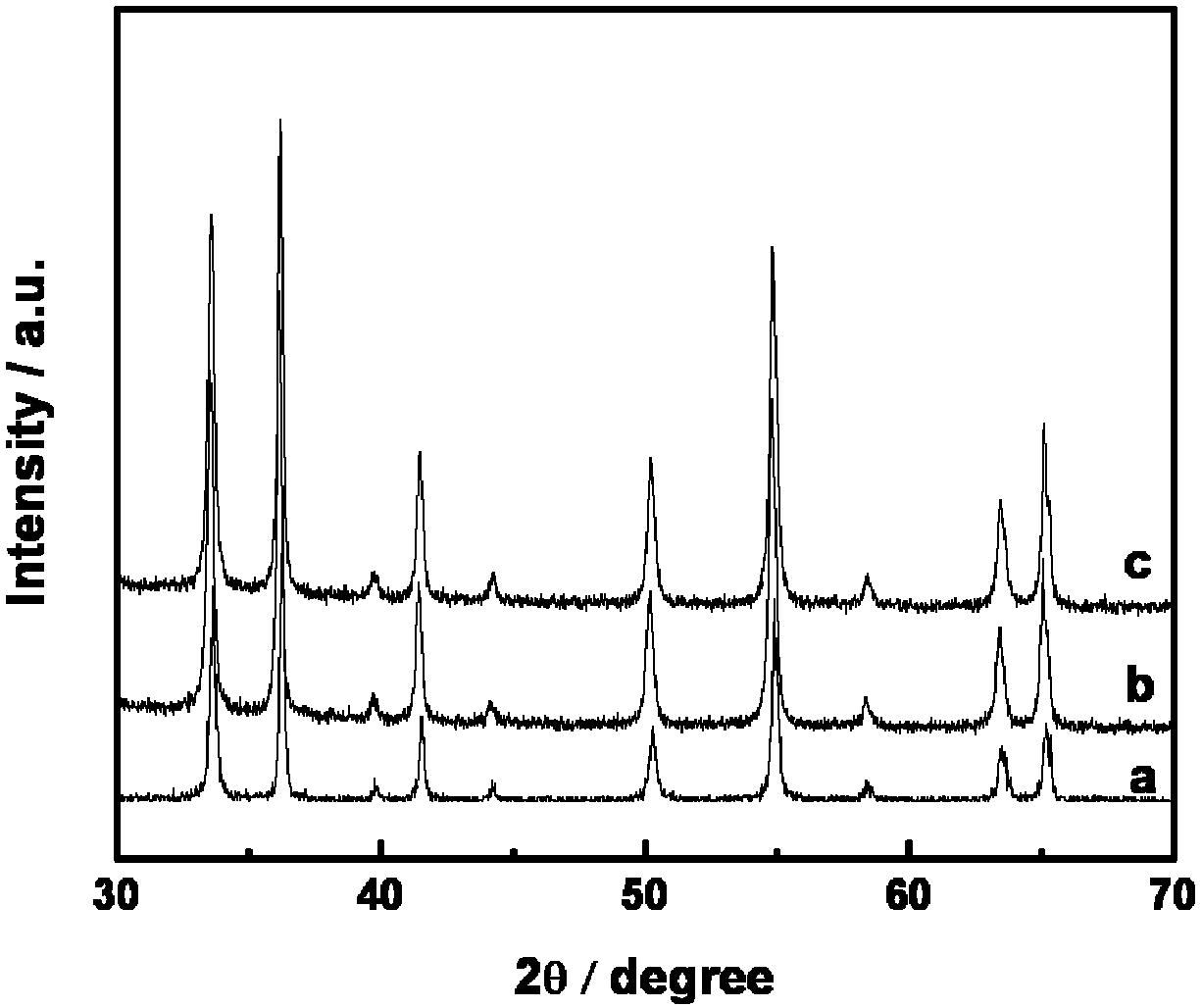

Figure S3. XRD patterns of porous chromium oxide spheres synthesized using different urea concentrations: 0 M (a), 0.06 M (b), and 0.12 M (c). Chromium nitrate concentration was held constant at 0.025 M.

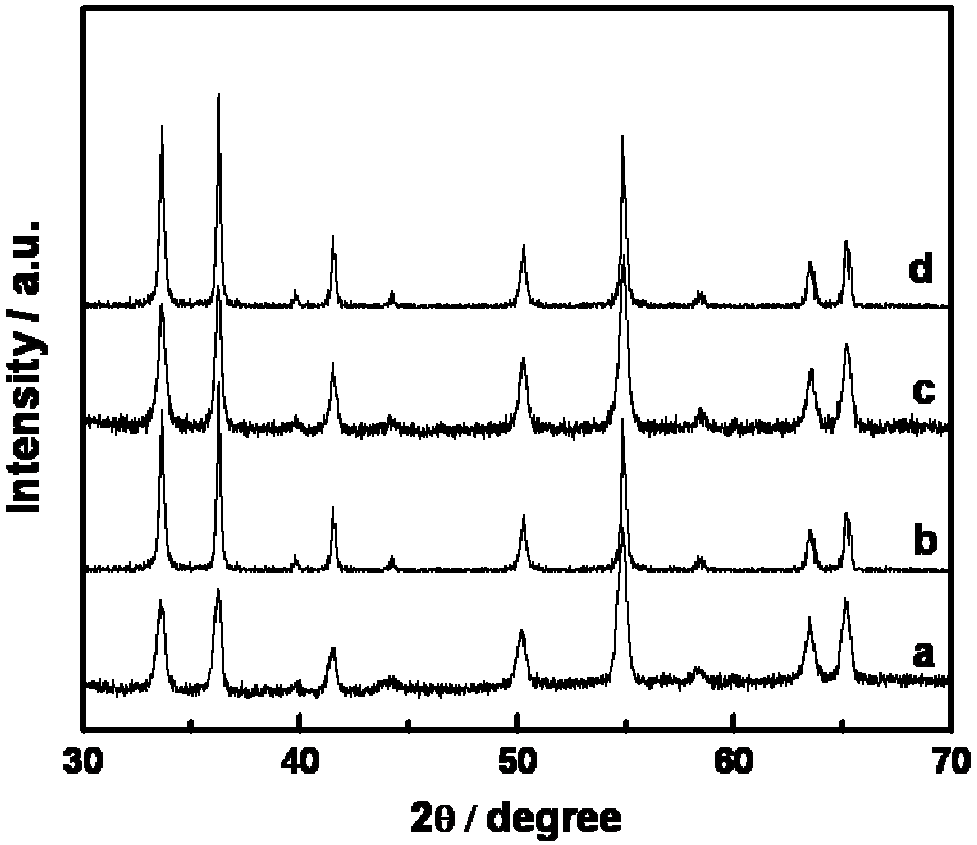

Figure S4. XRD patterns of porous chromium oxide spheres in the absence of urea. They were synthesized by chromium nitrate concentration of 0.018M (a), 0.025 M (b), 0.05 M (c), and 0.075 M (d).

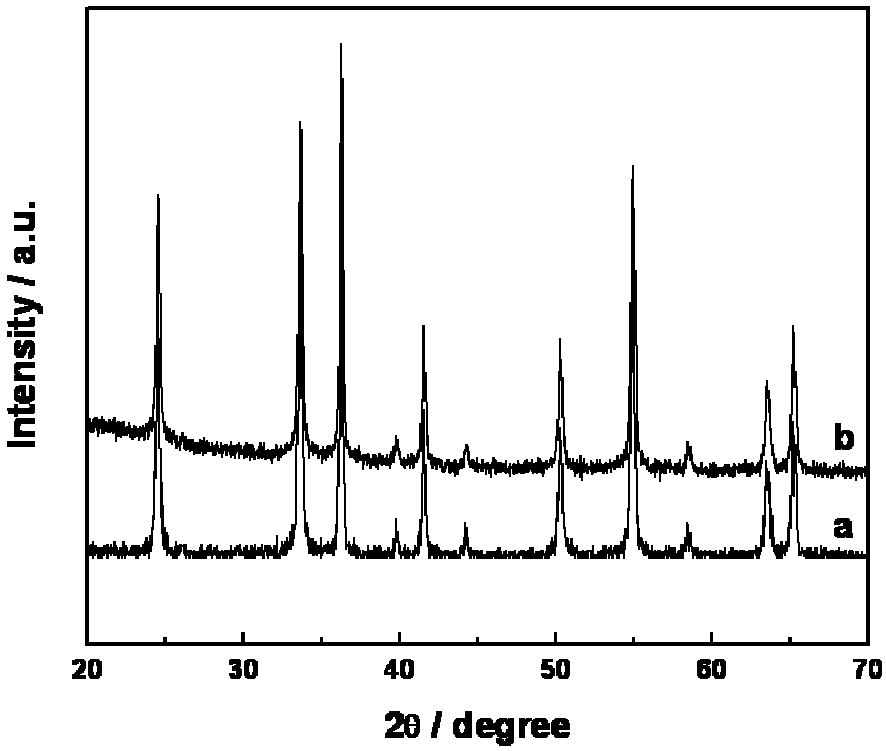

Figure S5. XRD patterns of new porous chromium oxide spheres (a) and regenerated porous chromium oxide spheres (b).

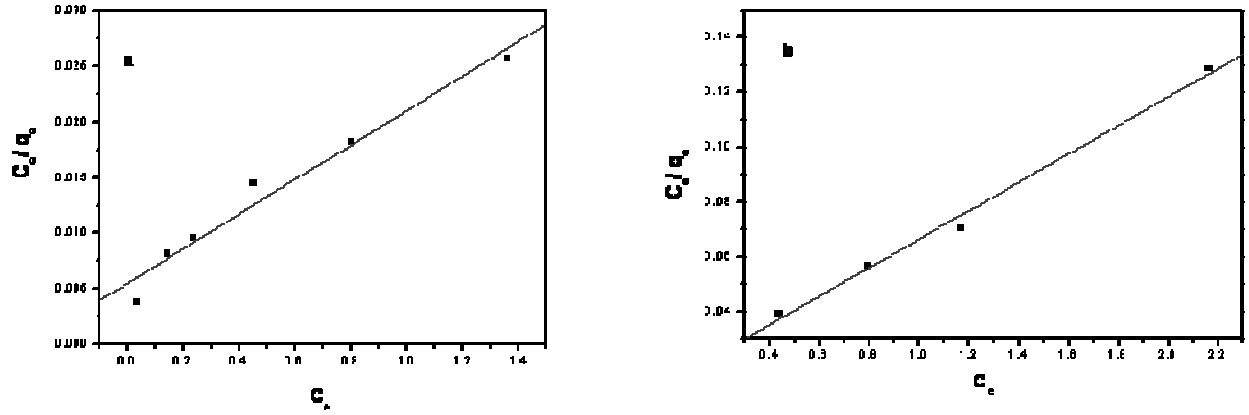

Figure S6. Langmuir isotherm plots of Congo red adsorption on porous Cr_2O_3 spheres (a) and CP-Cr_2O_3.

Table S2. Specific surface area and pore parameters of chromium oxides with different concentrations of urea and chromium nitrate.

Urea concentration (M)	Chromium nitrate concentration (M)	Surface area BET (m^2/g)	Pore size (nm)	Pore volume (cc/g)×10^{-2}
0	0.018	30	27.6	0.18
0	0.025	32	25.2	0.17
0	0.05	32	28.0	0.14
0	0.075	34	27.1	0.14
0.06	0.025	26	22.2	0.14
0.12	0.025	20	24.8	0.15

Table S3. Langmuir adsorption isotherm parameters of Congo red on porous Cr_2O_3 [(a)] spheres and CP-C_2O_3 [(b)].

Absorbent	q_{exp}	K	q_m	R^2
Porous Cr_2O_3 spheres	57.6	0.29	64.2	0.98317
CP-Cr_2O_3	16.8	3.25	19.2	0.99661