Binary ZnO/Zn-Cr nanospinel catalyst prepared by hydrothermal method for isobutanol synthesis from syngas

Xiaofeng Gao,[a,b] Yingquan Wu,[a] Tao Zhang,[a] LiyanWang,[a,b] Xiaoli Li,[a,b] Hongjuan Xie[a] and Yisheng Tan*[a,c]

[a] State Key Laboratory of Coal Conversion, Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan 030001, China. Email: tan@sxicc.ac.cn. Fax: +86 351 4044287.Tel: +86 351 4044287.

[b] University of Chinese Academy of Sciences, Beijing 100049, China

[c] National Engineering Research Center for Coal-Based Synthesis, Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan 030001, China

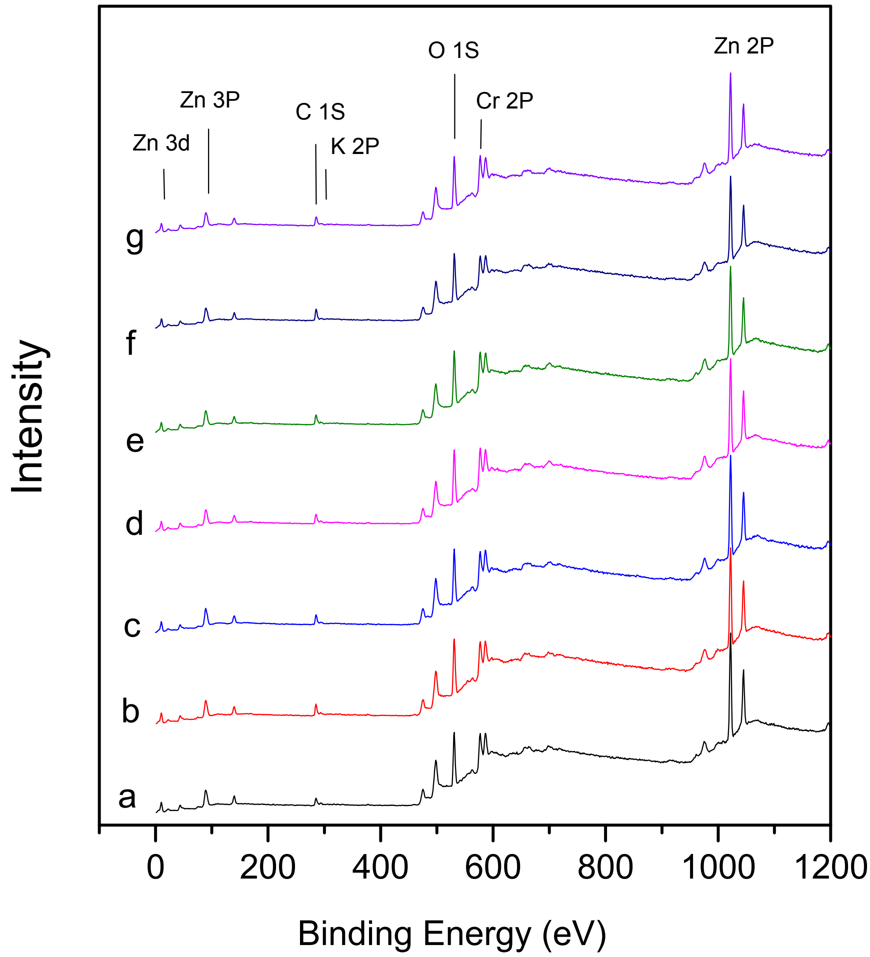

Fig. S1 XPS spectrum of ZnCr-x-100 and ZnCr-16-y catalysts: (a) ZnCr-8-100; (b) ZnCr-16-100; (c) ZnCr-24-100; (d) ZnCr-48-100; (e) ZnCr-16-80; (f) ZnCr-16-160; (g) ZnCr-16-160

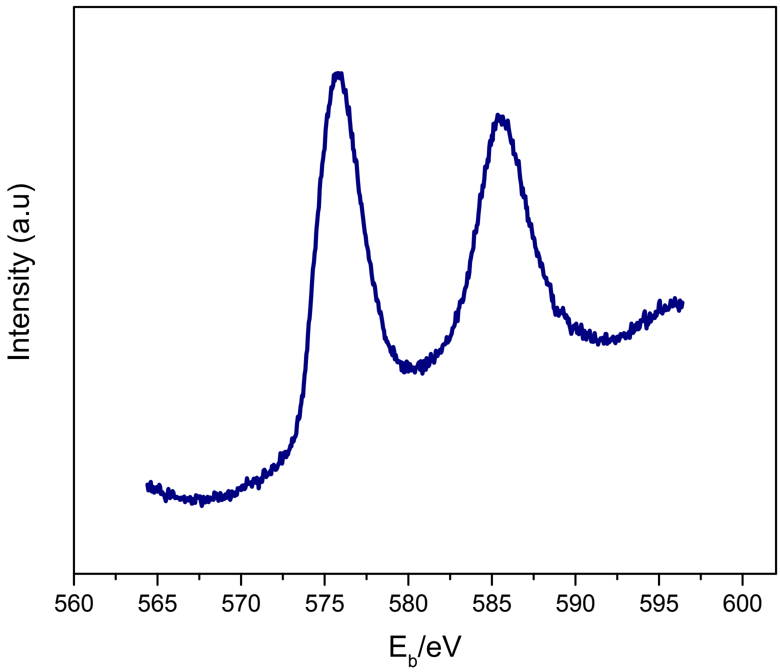

Fig. S2 The Cr 2p XPS spectrum of the reduced ZnCr-16-160 catalyst;

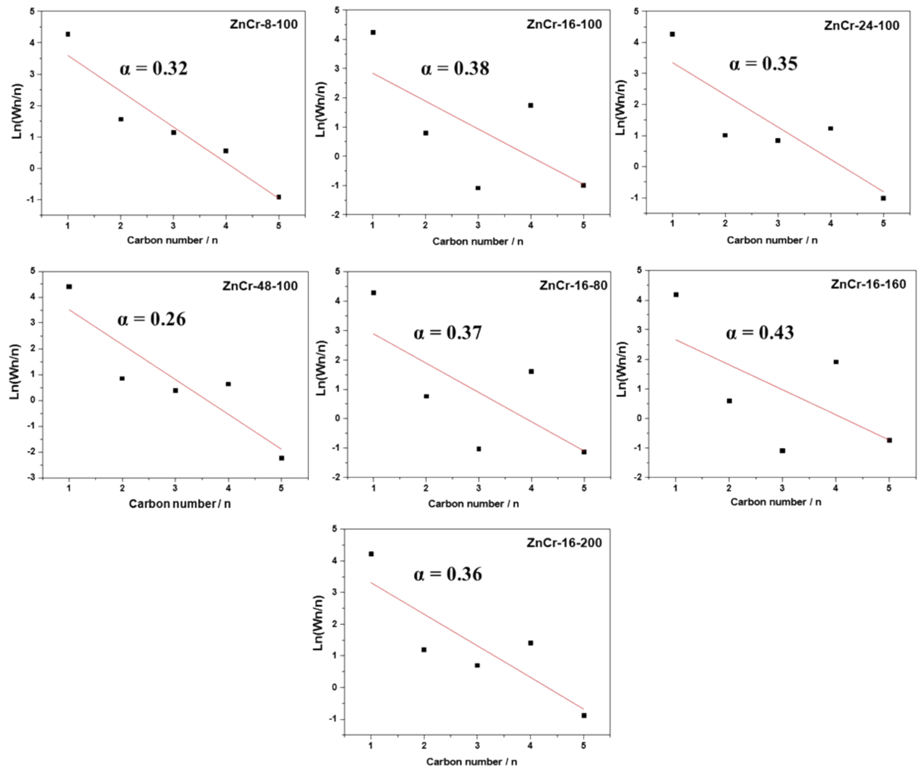

Fig. S3 Anderson–Schulz–Flory (ASF) plots for the distribution of alcohols for different catalysts at 10 h reaction. The ASF chain growth probability α of products is calculated according to the equation $\ln(W_n/n) = n\ln\alpha + \ln(1-\alpha)^2/\alpha$, in which n is the number of carbon atoms in products, Wn is the weight fraction of products containing n carbon atoms, and 1-α is the probability of chain termination.

Table S1 the catalytic performance of ZnCr catalysts by different methods

Catalysts	CO Conversion (%)	Alcohol Selectivity (%)	Total alcohol production rate (g • ml^{-1} • h^{-1})	Alcohol distribution (wt%)				
				MeOH	EtOH	n-PrOH	i-BuOH	C^{5+}OH
Comb-ZnCr [a]	**17.4**	**50.9**	**0.075**	**78.4**	**4.2**	**2.9**	**13.6**	**0.8**
Impr-ZnCr [b]	**19.7**	**38.6**	**0.063**	**73.4**	**2.7**	**3.2**	**18.0**	**1.7**
Copr-ZnCr [c]	**21.9**	**43.8**	**0.094**	**72.6**	**1.6**	**2.1**	**19.4**	**1.0**
Solgel-ZnCr [d]	**16.8**	**67.3**	**0.092**	**68.7**	**3.1**	**3.9**	**20.9**	**1.6**
Hydro-ZnCr [e]	**19.2**	**60.2**	**0.111**	**65.2**	**3.6**	**1.0**	**27.0**	**2.3**

[a] combustion method
[b] impregnation method
[c] co-precipitation method
[d] sol-gel method
[e] hydrothermal method