Electronic Supplementary Information (ESI)

Highly cost-effective and sulfur/coking resistant VO_x-grafted TiO_2 nanoparticles as an efficient anode catalyst for direct conversion of dry sour methane in solid oxide fuel cells

Alfonso Garcia[a], Ning Yan[b, a]*, Adrien Vincent[a], Anand Singh[c], Josephine M. Hill[c], Karl T. Chuang[a], Jing-Li Luo[a]*

[a] Department of Chemical and Materials Engineering, University of Alberta, Edmonton, Alberta, T6G 2V4, Canada. Fax: (+1) 780 492 2881; Tel: (+1) 780 492 2232. E-mail: jingli.luo@ualberta.ca

[b] Van't Hoff Institute for Molecular Sciences (HIMS), University of Amsterdam, Amsterdam, 1098XH, The Netherlands. Tel : (+31) 020 525 6468. E-mail : n.yan@uva.nl

[c] Department of Chemical and Petroleum Engineering, University of Calgary, Calgary, Alberta, T2N 1N4, Canada. Tel: (+1) 403 210 9488. E-mail: jhill@ucalgary.ca

Table S1 Peak positions and atomic ratios of V and Ti from XPS

	V 2p 3/2 (eV)	**Ti 2p 3/2 (eV)**	**O 1s (eV)**	**N_V/N_{Ti} (atomic ratio)**
VO_x/TiO_2 (25 °C)	517.27	458.2	529.8	0.16
VO_x/TiO_2 (800 °C in air)	517.07	458.6	529.8	0.15
VO_x/TiO_2 (800 °C in 0.5% H_2S+ CH_4)	517.13	458.2	529.8	0.21

Table S2 Comparison of SOFC non-ohmic polarization resistance using various anode materials in different methane gas fuels.

Anode Materials	**Fuel Gas**	**Non-ohmic Polarization Resistance (Ω cm^2)***	**Temperature (^{o}C)**	**Ref. No.**
$La_{0.75}Sr_{0.25}Cr_{0.5}Mn_{0.5}O_3$	CH_4	0.87	900	[32]
$La_4Sr_8Ti_{11}Mn_{0.5}Ga_{0.5}O_{38}$	CH_4	0.57	900	[8]
$Pr_{0.5}Ba_{0.5}MnO_3$	CH_4	~0.4	850	[16]
CeO_2**	CH_4	> 2	900	[33]
$Li_{0.33}La_{0.56}TiO_3$	0.1%H_2S + H_2	>0.35	800	[17]
$Ce_{0.9}Sr_{0.1}VO_3$	0.5%H_2S +CH_4	>17	900	[34]
$BaTiO_3$	0.5%H_2S +CH_4	> 10	900	[35]
LSBT	0.5%H_2S +CH_4	11.3	850	[36]
VO_x/TiO_2-LSBT	0.5%H_2S +CH_4	1.01	850	This work

Notes:

*: Cathode material used in all cases was Sr-doped $LaMnO_3$ except for work 16 and 17 which used NbSCF and BSCF, respectively.

**: CeO_2 was mixed with 50 wt% of $La_{0.6}Sr_{0.4}TiO_3$.