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研究论文



# Ni 掺杂对纳米结构牡丹花状 $CeO_2$ 材料催化特性的影响

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- 摘要
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摘要 制备了一种新型 Ni 掺杂多层纳米结构牡丹花状 $CeO_2$ 材料, 研究了其催化性能, 同时与 Ni 负载牡丹花状 $CeO_2$ 样品进行了比较. 结果表明, Ni 掺杂 $CeO_2$ 样品具有纳米晶粒和开放的介孔结构, 特殊的形貌使其在 CO 氧化和甲烷部分氧化反应中具有独特的催化特性. Ni 掺杂后, $CeO_2$ 中产生了多余氧空位, 同时其氧化还原活性也增强, 其在 CO 氧化反应中的催化活性明显高于纯 $CeO_2$ 和 Ni 负载 $CeO_2$ 样品; 在甲烷部分氧化反应中, 牡丹花状 $CeO_2$ 负载 3 atm% Ni 催化剂样品上甲烷转化率高于所有 Ni 掺杂的催化剂样品. 但是在 Ni 负载型催化剂和花状 $CeO_2$ 催化剂上, 甲烷的起始转化温度为 400 °C, 而 5.7 atm%Ni 的掺杂使其降至 340 °C.

关键词: 纳米结构氧化铈 镍 一氧化碳氧化 甲烷部分氧化

Abstract: Nanostructured ceria materials have attracted wide attention as catalysts, and the doping of these materials with rare earth elements to modify their catalytic activity has been comprehensively investigated. A novel type of Ni-doped hierarchical nanostructured peony-like ceria (PCO) has been prepared and its catalytic activity is investigated and compared with that of Ni-loaded samples. The prepared Ni-doped ceria have nanoscale grain sizes and open mesopores. This unique morphology endows it with superior catalytic activity for the oxidation of CO and the partial oxidation of methane. It is found that extra oxygen vacancies are generated in the ceria, and the reducibility of the ceria is highly enhanced after Ni-doping. The catalytic activity for CO oxidation is improved after Ni-doping, compared with that of pure ceria and Ni-loaded ceria. In the reaction for the partial oxidation of methane, the 3.8 atm% Ni-loaded PCO sample realizes a higher $CH_4$ conversion than the Ni-doped ceria. However, it is found that the onset temperature for $CH_4$ conversion decreases from 400 ° C for the pure PCO and 3.8 atm% Ni-loaded PCO sample, to 340 ° C for the 5.7 atm% Ni-doped PCO sample.

Keywords: nanostructured ceria, nickel, carbon monoxide oxidation, partial oxidation of methane

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[1] Liu W W, Zhou K B, Wang L, Wang B Y, Li Y D. J Am Chem Soc, 2009, 131: 3140

[2] Sun C W, Li H, Chen L Q. J Phys Chem Solids, 2007, 68: 1785

[3] 单文娟, 刘畅, 郭红娟, 杨利华, 王晓楠, 冯兆池. 催化学报 (Shan W J, Liu Ch, Guo H J, Yang L H, Wang X N, Feng Zh Ch. Chin J Catal), 2011, 32: 1336

[4] Carrettin S, Concepcion P, Corma A, Nieto J M L, Puntes V F. Angew Chem, Int Ed, 2004, 43: 2538

[5] Li Y, Fu Q, Flytzani-Stephanopoulos M. Appl Catal B, 2000, 27: 179

[6] Rim K T, Eom D, Liu L, Stolyarova E, Raitano J M, Chan S W, Flytzani-Stephanopoulos M, Flynn G W. J Phys Chem C, 2009, 113: 10198

[7] Wang K, Li X J, Ji S F, Shi X J, Tang J J. Energy Fuels, 2009, 23: 25

[8] Laosiripojana N, Assabumrungrat S. Appl Catal, 2006, 66: 29

[9] Trovarelli A. Catal Rev Sci Eng, 1996, 38: 439
[10] Huang T J, Wang C H. Chem Eng J, 2007, 132: 97
[11] Huang T J, Yu T C. Catal Lett, 2005, 102: 175
[12] Xiao G L, Li S, Li H, Chen L Q. Microporous Mesoporous Mater, 2009, 120: 426
[13] Yuan Q, Duan H H, Li L L, Li Z X, Duan W T, Zhang L S, Song W G, Yan C H. Adv Mater, 2010, 22: 1475
[14] Sun C W, Sun J, Xiao G L, Zhang H R, Qiu X P, Li H, Chen L Q. J Phys Chem B, 2006, 110: 13445
[15] Sun C W, Li H, Chen L Q. Energy Environ Sci, 2012, 5: 8475
[16] Xian C N, Li H, Chen L Q, Lee J S. Microporous Mesoporous Mater, 2011, 142: 202
[17] Sun J, Wang Y G, Li J G, Xiao G L, Zhang L G, Li H, Cheng Y L, Sun C W, Cheng Z X, Dong Z C, Chen L Q. Int J Hydrogen Energy, 2010, 35: 3087
[18] Sun C W, Xie Z, Xia C R, Li H, Chen L Q. Electrochem Commun, 2006, 8: 833
[19] Xiao G, Jiang Z, Li H, Xia C, Chen L Q. Fuel Cells, 2009, 9: 650
[20] Konyshev E, Blackley R, Irvine J T S. Chem Mater, 2010, 22: 4700
[21] York A P E, Xiao T C, Green M L H. Top Catal, 2003, 22: 345
[22] Tomishige K. J Jpn Pet Inst, 2007, 50: 287
[23] Ni M, Leung D Y C, Leung M K H. Int J Hydrogen Energy, 2007, 32: 3238
[24] Kugai J, Velu S, Song C S. Catal Lett, 2005, 101: 255
[25] Rasko J, Hancz A, Erdohelyi A. Appl Catal, 2004, 269: 13
[26] Bradford M C J, Vannice M A. Appl Catal, 1996, 142: 73
[27] Biswas P, Kunzru D. Catal Lett, 2007, 118: 36
[28] Huang T J, Huang M C, Huang M S. Appl Catal, 2009, 354: 127
[29] Sayle T X, Parker S C, Catlow S C C. Surf Sci, 1994, 316: 329
[30] Zhu T L, Flytzani-Stephanopoulos M. Appl Catal, 2001, 208: 403
[31] Kumar P, Sun Y P, Idem R O. Energy Fuels, 2008, 22: 3575
[32] Daza C E, Kiennemann A, Moreno S, Molina R. Appl Catal A, 2009, 364: 65
[33] Aupretre F, Descorme C, Duprez D. Catal Commun, 2002, 3: 263
[34] Moon D J. Catal Surv Asia, 2008, 12: 188
[35] Choudary V R, Rajput A M, Prabhakar B. J Catal, 1993, 139: 326
[36] Noronha F B, Fendley E C, Soares R R, Alvarez W E, Resasco D E. Chem Eng J, 2001, 82: 21
[37] Wang X Q, Rodriguez J A, Hanson J C, Gamarra D, Marti-nez-Arias A, Fernandez-Garcia M. J Phys Chem B, 2005, 109: 19595
[38] Thurber A, Reddy K M, Shutthanandan V, Engelhard M H, Wang C, Hays J, Punnoose A. Phys Rev B, 2007, 76: 165206-1
[39] Jalowiecki-Duhamel L, Ponchel A, Lamonier C. Int J Hydro-gen Energy, 1999, 24: 1083
[40] Yisup N, Cao Y, Feng W L, Dai W L, Fan K N. Catal Lett, 2005, 99: 207
[41] Kaneko H, Tamaura Y. J Phys Chem Solids, 2009, 70: 1008
[42] Mogensen M, Sammes N M, Tompsett G A. Solid State Ionics, 2000, 129: 63
[43] Thammachart M, Meeyoo V, Risksomboon T, Osuwan S. Catal Today, 2001, 68: 53
[44] Barrio L, Kubacka A, Zhou G, Estrella M, Martinez-Arias A, Hanson J C, Fernandez-Garcia M, Rodriguez J A. J Phys Chem C, 2010, 114: 12689
[45] McBride J R, Hass K C, Poindexter B D, Weber W H. J Appl Phys, 1994, 76: 2435
[46] Larese C, Granados M L, Mariscal R, Fierro J L G, Lambrou P S, Efstathiou A M. Appl Catal, 2005, 59: 13
[47] Hocevar S, Batista J, Levec J. J Catal, 1999, 184: 39
[48] Zhang F, Chen C H, Raitano J M, Hanson J C, Caliebe W A, Khalid S, Chan S W. J Appl Phys, 2006, 99: 084313
[49] 于强强, 李杨, 邹旭华, 卓红英, 姚媛媛, 索掌怀. 催化学报 (Yu Q Q, Li Y, Zou X H, Zhuo H Y, Yao Y Y, Suo Zh H. Chin J Catal), 2010, 31: 671

[50] Reddy B M, Bharali P, Saikia P, Park S E, van den Berg M W E, Muhler M, Grunert W. J Phys Chem C, 2008, 112: 11729

[51] Choisnet J, Klissurski D, Abadzhieva N, Stefanov P, Minchev L. J Chem Soc, Faraday Trans, 1994, 90: 1987

[52] Ivanova A S. Kinet Catal, 2009, 50: 797

[53] Liu W, Flytzani-Stephanopoulos M. Chem Eng J, 1996, 64: 283

[54] Ramesh K, Chen L W, Chen F X, Liu Y, Wang Z, Han Y F. Catal Today, 2008, 131: 477

[55] Cracium R, Nentwick B, Hadjiivanov K, Köninger H. Appl Catal A, 2003, 243: 67

[56] Molina L M, Hammer B. Phys Rev B, 2004, 69: 155424-1

[57] Kundakovic L, Flytzani-Stephanopoulos M. J Catal, 1998, 179: 203

[58] Choudhary V R, Rajput A M, Mamman A S. J Catal, 1998, 178: 576

[59] Zhu T L, Flytzani-Stephanopoulos M. Appl Catal A, 2001, 208: 4037

[60] Silva F A, Ruiz J A C, de Souza K, Bueno J M C, Mattos L V, Noronha F B, Hori C E. Appl Catal A, 2009, 364: 122

[1] 许士洪, 谭东栋, 鲁巍, 时鹏辉, 毕得福, 马春燕, 上官文峰.液相沉积法制备可磁分离复合光催化剂纳米球及其催化性能[J]. 催化学报, 2013,34(2): 367-372

[2] 陈国星, 李巧灵, 魏育才, 方维平, 杨意泉.镍促进 $CuO-CeO_2$ 催化剂的结构表征及低温 CO 氧化活性[J]. 催化学报, 2013,34(2): 322-329

[3] 张罕, 董云芸, 方维平, 连奕新.复合氧化物载体对镍基催化剂上 CO 甲烷化反应性能的影响[J]. 催化学报, 2013,34(2): 330-335

[4] 余运波, 赵娇娇, 韩雪, 张燕, 秦秀波, 王宝义.焙烧与预处理条件对 $Co_3O_4$ 催化氧化 CO 性能的影响[J]. 催化学报, 2013,34(2): 283-293

[5] 瑙莫汗, 付晓娟, 雷艳秋, 苏海全.介孔Ni-*b*--$Mo_2C$/SBA-16催化剂在$CH_4/CO_2$重整制合成气反应中的催化性能[J]. 催化学报, 2013,34(2): 379-384

[6] 娄舒洁, 肖超贤, 孙耿, 寇元.由苯制备环己醇新途径[J]. 催化学报, 2013,34(1): 251-256

[7] 张玉良, 杨永兴, 林峰, 杨民, 刘铁峰, 蒋宗轩, 李灿.Mn掺杂对Ni/ZnO吸附剂脱硫性能的改进[J]. 催化学报, 2013,34(1): 140-145

[8] 白玉婷, 朱学成, 张利雄, 徐南平.Ni/$SiO_2$ 和 $SO_3H$-C/SBA-15 复合催化剂上硝基苯加氢制对氨基苯酚[J]. 催化学报, 2013,34(1): 263-271

[9] 孔猛, 杨琦, 卢雯, 范浙永, 费金华, 郑小明, Thomas D. WHEELOCK.焙烧温度对 Ni/MgO 催化剂结构及其在甲苯二氧化碳重整反应中催化性能的影响[J]. 催化学报, 2012,33(9): 1508-1516

[10] 刘莹, 王胜, 高典楠, 潘秋实, 王树东.Pd/$NiAl_2O_4$ 催化剂上甲烷燃烧反应的红外光谱研究[J]. 催化学报, 2012,33(9): 1552-1557

[11] 刘莹, 王胜, 高典楠, 王树东.Ni 的引入对 Pd/$Al_2O_3$ 催化甲烷燃烧性能的影响[J]. 催化学报, 2012,33(8): 1354-1359

[12] 胡基业, 刘晓钰, 王彬, 裴燕, 乔明华, 范康年.制备方法对 Ni/ZnO 催化丙三醇重整-氢解性能的影响[J]. 催化学报, 2012,33(8): 1266-1275

[13] 闫少伟, 范辉, 梁川, 李忠, 于智慧.二硝基甲苯低压加氢 Ni-La-B 非晶态合金催化剂的制备及结构表征[J]. 催化学报, 2012,33(8): 1374-1382

[14] 冯连荣, 胡丰田, 刘成宝, 陈丰, 徐楠, 刘守清, 陈志刚.活性炭-铁酸镍磁性催化剂的光催化性能[J]. 催化学报, 2012,33(8): 1417-1422

[15] 王达, 张因, 李海涛, 赵丽丽, 张鸿喜, 赵永祥.Ni-Cu/$Al_2O_3$ 催化剂上顺酐液相选择加氢制丁二酸酐反应性能[J]. 催化学报, 2012,33(7): 1229-1235