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研究论文

CeO_2-MnO_x 催化剂上氯乙烯有机废气的催化燃烧

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- 摘要
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摘要 采用柠檬酸 (CA) 溶胶-凝胶法制备了不同 Mn:(Ce+Mn) 摩尔比的CeO_2-MnO_x 催化剂, 以氯乙烯有机废气的催化燃烧为模型反应, 考察了催化剂制备条件和反应条件对于 CeO_2-MnO_x 催化剂性能的影响, 并用 N_2 吸附、X 射线衍射 (XRD) 和 H2 程序升温还原 (H_2-TPR) 对催化剂进行了表征. 结果表明, CeO_2-MnO_x 催化剂上氯乙烯燃烧反应产物只有 HCl, H_2O 和 CO_2, 没有检测到其他氯代烃和氯气等副产物. 当 CA:Mn:Ce = 0.3:0.50:0.50 时, 所制备的 CeO_2-MnO_x 催化剂活性最高, 对于较宽的空速范围 (10000~30000 h^{-1}) 和较宽的浓度范围 (0.05%~0.15%), 低浓度氯乙烯的催化燃烧反应具有较好的操作弹性. 其中当氯乙烯浓度为 0.1%, 空速为 15000 h^{-1}时, 起燃温度 T50 = 110 ^{o}C, 完全转化温度 T99 = 220 ^{o}C. XRD 和 H_2-TPR 结果表明, 在 CeO_2-MnO_x 催化剂中只出现立方相萤石结构 CeO_2 的特征衍射峰, 没有出现 MnO_x 物种的特征衍射峰; Mn 离子进入 CeO_2 晶格形成的 Ce-Mn-O 固溶体, 有利于提高催化剂表面的活性氧物种的活性, 乃至催化剂活性.

关键词: 铈 锰 复合氧化物 氯乙烯 催化燃烧 固溶体 氧物种

Abstract: CeO_2-MnO_x catalyst samples with different Mn/(Ce+Mn) molar ratios (0, 1/4, 1/2, 3/4, and 1) prepared by the citric acid (CA) sol-gel method were studied for catalytic combustion of vinyl chloride (VC) emission. The effects of preparation conditions and operation parameters on the catalytic performance of CeO_2-MnO_x were investigated. The catalyst samples were characterized by N_2 adsorption, X-ray diffraction (XRD), and H_2 temperature-programmed reduction (H_2-TPR). In the catalytic combustion of VC over CeO_2-MnO_x, the products containing HCl, CO_2, and H_2O were produced and there were no byproducts such as chlorohydrocarbons and chlorine. The CeO_2-MnO_x catalyst with the molar ratio of CA:Mn:Ce = 0.30:0.50:0.50 showed the best catalytic performance and had better operating flexibility over the ranges of gas hourly space velocity (GHSV) of 10000–30000 h^{-1} and VC concentration of 0.05%–0.15%. The temperatures at 50% conversion (110 ^{o}C) and at 99% conversion (220 ^{o}C) were achieved at VC concentration of 0.1% and GHSV of 15000 h^{-1}. XRD characterization indicated that only the characteristic diffraction peaks of CeO_2 with the cubic fluorite structure appeared and no characteristic diffraction peaks of MnO_x species appeared over CeO_2-MnO_x catalyst. XRD and H_2-TPR results indicated that Mn ions were incorporated into the CeO_2 lattice to form Ce-Mn-O solid solution, which was favorable for improving the reactivity of active oxygen species on the catalyst surface and thereby enhanced the catalyst activity.

Keywords: cerium, manganese, composite oxide, vinyl chloride, catalytic combustion, solid solution, oxygen species

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[1] Hiraoka M, Sakai S, Sakagawa T, Hata Y. Organohalogen Compd, 1997, 31: 446

[2] 李鹏, 何炽, 程杰, 郝郑平. 物理化学学报 (Li P, He Ch, Cheng J, Hao Zh P. Acta Phys-Chim Sin), 2009, 25: 2279

[3] Giraudon J M, Elhachimi A, Leclercq G. Appl Catal B, 2008, 84: 251

[4] Guillemot M, Mijoin J, Mignard S, Magnoux P. Appl Catal A, 2007, 327: 211

[5] Aranzabal A, Gonzalez-Marcos J A, Romero-Saez M, Gonzalez-Velasco J R, Guillemot M, Magnoux P. Appl Catal B, 2009, 88: 533

[6] Choi J S, Youn H K, Kwak B H, Wang Q, Yang K S, Chung J S. Appl Catal B, 2009, 91: 210
[7] de Rivas B, Lopez-Fonseca R, Sampedro C, Gutierrez- Ortiz J I. Appl Catal B, 2009, 90: 545
[8] Müller H, Deller K, Despeyroux B, Peldszus E, Kammer-hofer P, Kühn W, Spielmannleitner R, Stöger M. Catal To-day, 1993, 17: 383
[9] Van den Brink R W, Louw R, Mulder P. Appl Catal B, 1998, 16: 219
[10] Finocchio E, Sapienza G, Baldi M, Busca G. Appl Catal B, 2004, 51: 143
[11] de Rivas B, López-Fonseca R, Gutiérrez-Ortiz M Á, Gutiérrez-Ortiz J I. Appl Catal B, 2011, 101: 317
[12] de Rivas B, López-Fonseca R, González-Velasco J R, Gutiérrez-Ortiz J I. J Mol Catal A, 2007, 278: 181
[13] Zhou J M, Zhao L, Huang Q Q, Zhou R X, Li X K. Catal Lett, 2009, 127: 277
[14] Huang Q Q, Xue X M, Zhou R X. J Hazard Mater, 2010, 183: 694
[15] Huang Q Q, Xue X M, Zhou R X. J Mol Catal A, 2010, 331: 130
[16] Fan X Y, Yang H S, Tian W, Nie A M, Hou T F, Qiu F M, Zhang X B. Catal Lett, 2011, 141: 158
[17] Wang X Y, Kang Q, Li D. Catal Commun, 2008, 9: 2158
[18] Wang X Y, Kang Q, Li D. Appl Catal B, 2009, 86: 166
[19] Yamamoto K, Takamitsu K. JP2008006323. 2008
[20] Machida M, Uto M, Kurogi D, Kijima T. Chem Mater, 2000, 12: 3158
[21] Murugan B, Ramaswamy A V, Srinivas D, Gopinath C S, Ramaswamy V. Chem Mater, 2005, 17: 3983

[1] 黄健, 马人熊, 高志华, 沈朝峰, 黄伟.CeO_2/Ni/Mo/SBA-15 甲烷二氧化碳重整催化剂的表征和催化性能[J]. 催化学报, 2012,33(4): 637-644
[2] 林建新, 张留明, 王自庆, 王榕, 魏可镁.Pr 掺杂对 Ru/CeO_2 催化剂结构和氨合成性能的影响[J]. 催化学报, 2012,33(3): 536-542
[3] 赵德志, 丁天英, 李小松, 刘景林, 石川, 朱爱民.室温 MnO_x 上 O_3 氧化脱除空气中甲醛[J]. 催化学报, 2012,33(3): 396-401
[4] 方星, 陈崇启, 林性贻*, 余育生, 詹瑛瑛, 郑起.La_2O_3 对 CuO/CeO_2 水煤气变换反应催化剂微观结构及催化性能的影响[J]. 催化学报, 2012,33(3): 425-431
[5] 庞潇健, 陈亚中, 代瑞旗, 崔鹏.柠檬酸络合法制备的 Co/CeO_2 催化剂上中温乙醇水蒸气重整性能[J]. 催化学报, 2012,33(2): 281-289
[6] 闫朝阳, 兰丽, 陈山虎, 赵明, 龚茂初, 陈耀强*.高性能 $Ce_{0.5}Zr_{0.5}O_2$ 稀土储氧材料的制备及其负载的单 Pd 三效催化剂[J]. 催化学报, 2012,33(2): 336-341
[7] 王月娟, 郭美娜, 鲁继青, 罗孟飞.介孔 Al_2O_3 负载 PdO 催化甲烷燃烧反应性能[J]. 催化学报, 2011,32(9): 1496-1501
[8] 钟富兰, 钟喻娇, 肖益鸿, 蔡国辉, 郑勇, 魏可镁.Pt/CeO_2-ZrO_2-La_2O_3 柴油车尾气氧化催化剂活性及抗硫性能[J]. 催化学报, 2011,32(9): 1469-1476
[9] 张佳瑾, 李建伟*, 朱吉钦, 王越, 陈标华.助剂对 Cu-Mn 复合氧化物整体式催化剂催化低浓度甲烷燃烧反应性能的影响[J]. 催化学报, 2011,32(8): 1380-1386
[10] 杨文, 储伟, 江成发*, 文婕, 孙文晶.CeO_2 助 Ni/MgO 催化剂用于化学气相沉积法制备多壁碳纳米管[J]. 催化学报, 2011,32(8): 1323-1328
[11] 单文娟1,*, 刘畅1, 郭红娟1, 杨利华1, 王晓楠1, 冯兆池2.0, 1, 3 维 CeO_2 的可控制备及 CuO/CeO_2 催化剂上 CO 氧化反应[J]. 催化学报, 2011,32(8): 1336-1341
[12] 王仕发1,2, 杨华1,2,*, 县涛1,2.新型半导体可见光催化剂纳米锰酸钇[J]. 催化学报, 2011,32(7): 1199-1203
[13] 余育生, 孙伟华, 詹瑛瑛, 林性贻, 郑起*.$Au/Cu_xMn_yO_z$ 催化剂的制备、表征及其 CO 消除性能[J]. 催化学报, 2011,32(7): 1220-1226
[14] 邱春天, 林涛*, 张秋林, 徐海迪, 陈耀强, 龚茂初*.改性 ZrO_2-MnO_2 基整体式催化剂上 NH_3 选择性催化还原 NO[J]. 催化学报, 2011,32(7): 1227-1233
[15] 潘浩, 周丽娜, 朱艺, 彭娜, 龚茂初, 陈耀强*.尿素水解法制备降解地表臭氧的 $Pd\text{-}MnO_x/Al_2O_3$ 催化剂[J]. 催化学报, 2011,32(6): 1040-1045