

## 研究论文

### Sm<sup>3+</sup>掺杂对SmxNiCo0.2Mn1.8O4热敏陶瓷性能的影响

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**摘要:** 采用室温固相法和烧结工艺制备SmxNiCo0.2Mn1.8O4(0≤x≤0.05)负温度系数热敏陶瓷,用XRD和XPS等手段对其进行表征,研究了Sm<sup>3+</sup>掺杂对其电性能的影响。结果表明,当Sm<sup>3+</sup>掺杂量较低时(x≤0.02),可以制备出单一的尖晶石相,Sm<sup>3+</sup>取代尖晶石相八面体间隙中Mn<sup>3+</sup>有利于获得高热稳定性的尖晶石相;当Sm<sup>3+</sup>掺杂量x≥0.03时,相继出现SmMnO3和SmMn2O5两杂相,导致SmxNiCo0.2Mn1.8O4热敏陶瓷的热稳定性明显降低。

**关键词:** 无机非金属材料 NTC热敏陶瓷 SmxNiCo0.2Mn1.8O4 尖晶石相 XPS 电性能

### Effect of Sm<sup>3+</sup> Doping on the Properties of Thermoceramics SmxNiCo0.2Mn1.8O4

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**Abstract:** The NTC thermoceramics of SmxNiCo0.2Mn1.8O4(0≤x≤0.05) were prepared by the solid reaction technique and characterized by XRD and XPS. The influence of Sm<sup>3+</sup> doping on the electrical properties of SmxNiCo0.2Mn1.8O4 spinel phases was investigated. The results show that when Sm<sup>3+</sup> doped content was low(x≤0.02), Sm<sup>3+</sup> ions partially substituted Mn<sup>3+</sup> ions in the octahedral sites of the SmxNiCo0.2Mn1.8O4 spinel phases. It is beneficial to obtain high thermal stability of the spinel phases. While Sm<sup>3+</sup> doped content was higher than 0.03, SmMnO3 and SmMn2O5 two impurity phases precipitated one after one and the thermal stability of thermoceramics decreased significantly.

**Keywords:** inorganic non-metallic materials NTC thermoceramics SmxNiCo0.2Mn1.8O4 spinel phase XPS electrical properties

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## 参考文献:

- [1] M.Vakiv, O.Shpotyuk, O.Mrooz, I.Hadzaman, Controlled thermistor effect in the system CuxNi1-x-yCo2yMn2-yO4, Journal of the European Ceramic Society, 21, 1783-1785 (2001)

- [2] E.G.Larson, R.J.Arnott, D.G.Wikham, Preparation, semiconduction and low-temperature magnetization of the system  $\text{Ni}_{1-x}\text{Mn}_{12+x}\text{O}_4$ , *Journal of Physics and Chemistry of Solids*, 23, 1771-1781(1962) 
- [3] A.Navrotsky, O.J.Kleppa, The thermodynamics of cation distributions in simple spinels, *Journal of Inorganic & Nuclear Chemistry*, 29, 2701-2714(1967) 
- [4] K.Park, I.H.Han, Effect of  $\text{Cr}_2\text{O}_3$  addition on the microstructure and electrical properties of Mn-Ni-Co oxides NTC thermistors, *Journal of Electroceramics*, 17, 1069-1073(2006) 
- [5] M.Hosseini, The effect of cation composition on the electrical properties and aging of Mn-Co-Ni thermistors, *Ceramics International*, 26, 245-249(2000) 
- [6] K.Park, J.K.Lee, J.G.Kim, S.Nahm, Improvement in the electrical stability of Mn-Ni-Co-O NTC thermistors by substituting  $\text{Cr}_2\text{O}_3$  for  $\text{Co}_3\text{O}_4$ , *Journal of Alloys and Compounds*, 437, 211-214(2007) 
- [7] K.Park, J.K.Lee, S.-J.Kim, W.-S.Seo, W.-S.Cho, C.-W.Lee, S.Nahm, The effect of Zn on the microstructure and electrical properties of  $\text{Mn}_{1.17-x}\text{Ni}_{0.93}\text{Co}_{0.9}\text{Zn}_x\text{O}_4$  ( $0 \leq x \leq 0.075$ ) NTC thermistors, *Journal of Alloys and Compounds*, 467, 310-316(2009) 
- [8] K.Park, S.J.Kim, J.-G.Kim, S.Nahm, Structural and electrical properties of MgO-doped  $\text{Mn}_{1.4}\text{Ni}_{1.2}\text{Co}_{0.4-x}\text{Mg}_x\text{O}_4$  ( $0 \leq x \leq 0.25$ ) NTC thermistors, *Journal of the European Ceramic Society*,  
 [9] , 2009-2016(2007)
- [10] K.park, D.Y.Bang, Electrical properties of NiMnCoFe oxide thick-film NTC thermistors prepared by screen printing, *Journal of Materials Science-Materials in Electronics*, 14, 81-87(2003) 
- [11] V.L.Joseph Joly, P.A.Joy, S.K.Date, Effect of R on the magnetic transition temperature of  $\text{RMn}_{0.5}\text{Co}_{0.5}\text{O}_3$ , *Solid State Communications*, 121, 219-222(2002) 
- [12] V.L.Joseph Joly, S.D.Bhame, P.A.Joy, S.K.Date, Magnetic properties of  $\text{La}_2\text{MnCo}_{1-x}\text{Fe}_x\text{O}_6$ , *Journal of Magnetism and Magnetic Materials*, 261, 433-441 (2003) 
- [13] Yanwen Tian, Xiaoxue Kang, Liying Liu, Chaqing Xu, Tao Qu, Research on cathode material of Li-ion battery by yttrium doping, *Journal of Rare Earths*, 26, 279-283(2008) 
- [14] G.H.Zheng, Z.X.Dai, Y.Y.Zhang, Y.P.Sun, The influence of Sm doping in the electron-doped manganites  $\text{La}_{0.9}\text{Te}_{0.1}\text{MnO}_3$ , *Journal of Alloys and Compounds*, 489, 348-352 (2010) 
- [15] Zhang Na, TANG Zhiyuan, Huang Qing-hua, Lu Xinghe, Synthesis and characterization of multidoped lithium manganese oxide spinel  $\text{LiCo}_{0.02}\text{La}_{0.01}\text{Mn}_{1.97}\text{O}_{3.98}\text{Cl}_{0.02}$ ,  
 [16] *Transactions of Nonferrous Metals Society of China*, 16, 286-289(2006)
- [17] Yi Tingfeng, Zhu Yanrong, Hu Xinguo, Structure and electrochemical properties of  $\text{LiLa}_x\text{Mn}_{2-x}\text{O}_4$  cathode material by the ultrasonic-assisted sol-gel method. *International*,  
 [18] *Journal of Minerals Metallurgy and Materials*, 16, 119-123(2009)
- [19] E.Elbadraoui, J.L.Baudour, F.Bouree, B.Gillot, S.Fritsch, A.Rousset, Cation distribution and mechanism of electrical conduction in nickel-copper manganite spinels, *Solid State Ionics*, 93, 219-225(1997) 

- [20] S.Fritscha, J.Sarrias, M.Brieu, J.J.Couderc, J.L.Baudour, E.Snoeck, and A.Rousset, Correlation between the structure, the microstructure and the electrical properties of nickel manganite negative temperature coefficient (NTC) thermistors, *Solid State Ionics*, 109, 229-237(1998) 
- [21] D.Kukuruznyak, J.Moyer, N.Nguyen, E.Stern, F.Ohuchi, Relationship between electronic and crystal structure in Cu-Ni-Co-Mn-O spinels Part A: Temperature-induced structural transformation, *Journal of Electron Spectroscopy and Related Phenomena*, 150, 275 (2006) 
- [22] B.Gillot, R.Legros, R.Metz, A.Rousset, Electrical conductivity of copper and nickel manganites in relation with the simultaneous presence of Mn<sup>3+</sup> and Mn<sup>4+</sup> ions on octahedral sites of the spinel structure, *Solid State Ionics*, 51, 7-9(1992) 
- [23] D.R.Lide, ed. CRC Handbook of Chemistry and Physics. 80th ed. London: CRC Press. 1999.
- [24] D.L.Fang, C.H.Zheng, C.S.Chen, Aging of nickel manganite NTC ceramics, *Journal of Electroceramics*, 22, 421(2009) 
- [25] M.M.Vakiv, O.I.Shpotyuka, V.O.Balitska, Ageing behavior of electrical resistance in manganite NTC ceramics, *Journal of the European Ceramic Society*, 24, 1243-1246 (2004) 
- [26] D.L.Fang, Z.B.Wang, P.H.Yang, W.Liu, C.S.Chen, Preparation of ultra-fine nickel manganite powders and ceramics by a solid-state coordination reaction, *Journal of the American Ceramic Society*, 89, 230-235(2006) 

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1. 吕滨 孙旭东 孙挺 王毅.用微波均相沉淀法合成Sc<sub>2</sub>O<sub>3</sub>纳米粉[J]. 材料研究学报, 2011,25(3): 255-258
2. 张妍 周科朝 张晓冰 张斗.用冰模板法制备羟基磷灰石多孔陶瓷[J]. 材料研究学报, 2011,25(3): 289-294
3. 刘立恒 辜敏 鲜学福 喻江涛.粘结剂对颗粒活性炭PSA分离CH<sub>4</sub>/N<sub>2</sub>性能的影响[J]. 材料研究学报, 2011,25(3): 249-254
4. 魏榕山 丁晓琴 何明华.快速热退火对多层Ge量子点晶体质量的影响[J]. 材料研究学报, 2011,25(3): 259-262
5. 曹政 蒋百灵 鲁媛媛 王涛.磁场非平衡度对CrN<sub>x</sub>镀层性能的影响[J]. 材料研究学报, 2011,25(3): 313-320
6. 陈文国 代建清 丁耀民 夏井兵.热处理对Ba<sub>2</sub>Co<sub>0.6</sub>Zn<sub>1.0</sub>Cu<sub>0.4</sub>Fe<sub>12</sub>O<sub>22</sub>(Co<sub>2</sub>Y)铁氧体磁性能的影响[J]. 材料研究学报, 2011,25(3): 308-312
7. 李松 张跃.前驱体转化低铝含量非晶Si--Al--C--N的高温析晶行为[J]. 材料研究学报, 2011,25(3): 237-242
8. 楼白杨 陈茂军 杨京 徐斌.碱性介质中Pd/Sn石墨电极的电催化性能[J]. 材料研究学报, 2011,25(3): 333-336
9. 吴法宇 张峻巍 周艳文 李维娟.基于双带模型的螺旋碳纤维电导特性[J]. 材料研究学报, 2011,25(2): 187-192
10. 王景 苏革 曹立新 柳伟 董征 赵莉丽 宋美芹.钴掺杂对氧化镍薄膜电致变色性能的影响[J]. 材料研究学报, 2011,25(2): 179-182