JOURNAL OF SOLID STATE CHEMISTRY **130,** 152–153 (1997)
ARTICLE NO. SC967239

BRIEF COMMUNICATION

Influence of Sr Content on the Ethanol Sensitivity of Nanocrystalline $La_{1-x}Sr_xFeO_3$[1]

Hui Suo,* Jing Wang,* Fengqing Wu,† Guofan Liu,* Baokun Xu,* and Muyu Zhao†

**Department of Electronic Engineering and †Department of Chemistry, Jilin University, Changchun 130023, People's Republic of China*

Received December 18, 1995; in revised form November 18, 1996; accepted November 20, 1996

Using citrate method, we synthesized nanocrystalline material $La_{1-x}Sr_xFeO_3$ ($x = 0$–0.4), and then investigated its ethanol sensitivity to the content of strontium. © 1997 Academic Press

Composite oxides such as $La_{1-x}Sr_xFeO_3$ with perovskite structures (1) can be used as the catalysis materials (2). $LaFeO_3$ was reported in the early 1970s to be a gas sensing material with high sensitivity to ethanol (3, 4). Nanocrystalline materials (5) can improve the gas sensing properties due to their small size, large specific surface area, and strong surface activation (6). We studied the ethanol sensing properties of nanocrystalline $LaFeO_3$. The results show that (7), compared with conventional materials, the nanocrystalline $LaFeO_3$ sensors possess higher sensitivity, better selectivity, obviously improved response–recover characteristics, but higher resistance. To reduce the resistance, we add Sr^{2+} into $LaFeO_3$ to synthesize the nanocrystalline $La_{1-x}Sr_xFeO_3$ with perovskite structure.

Nanocrystalline $La_{1-x}Sr_xFeO_3$ ($x = 0$–0.4) was synthesized by the citrate method with calcining temperature 500°C for 2 h (7). We obtained the products with similar size by controlling the calcining time and temperature of the above materials. The TEM photograph shows that the particle sizes of the products are about 10 nm. XRD measurements show that the products we made are all of perovskite structure.

Figure 1 depicts the curve of static resistance versus Sr content (x) of $La_{1-x}Sr_xFeO_3$ ($x = 0$–0.4) sensors. We can see that the change of resistance does not depend monotonously on the amount of Sr, and that $x = 0.2$ is a singular point, where the resistance of the sensor is very large, roughly one order higher than the other materials. Repeated experiments show that this is not an accidental phenomenon. From this figure one can find that the resistance is also influenced by the heating condition. In the high temperature (~350°C, heating current $I = 130$ mA) region the resistance shows no obvious dependence on the Sr content. But within the lower temperature region (~200°C, $I = 90$ mA), with $x = 0.2$ as an exception, adding Sr decreases the resistance.

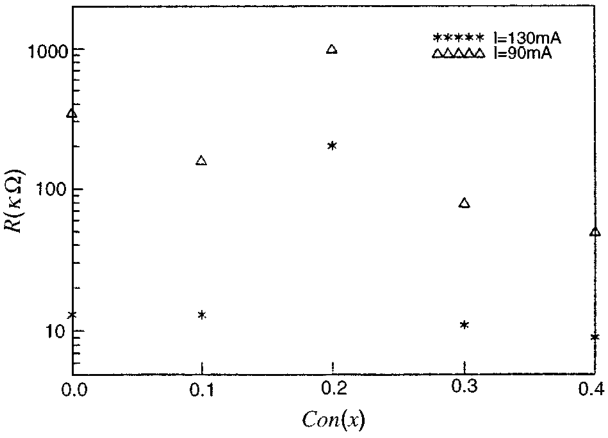

FIG. 1. Static resistance versus Sr content (x) of $La_{1-x}Sr_xFeO_3$ ($x = 0$–0.4).

The curves in Fig. 2 depict the sensitivity of $La_{1-x}Sr_xFeO_3$ ($x = 0 \sim 0.4$) to 100 ppm ethanol gas versus the heating current. The sensitivity factor β is defined as $\beta = R_x/R_0$, where R_x is the resistance measured in working circumstance, and R_0 in air. Here β for $La_{0.8}Sr_{0.2}FeO_3$ is again exceptionally high, while for the other materials, β goes down as x increases, especially when $I < 100$ mA.

The dashed lines in Fig. 2 give the resolution curves of $\beta'(= \beta_{ethanol}/\beta_{gasoline})$ of the five kinds of gas sensors ($x = 0$–0.4) to 100 ppm ethanol and 1000 ppm gasoline versus the heating current I. Comparing them with the curves

[1] Research supported by the National Science Fund of China.

0022-4596/97 $25.00

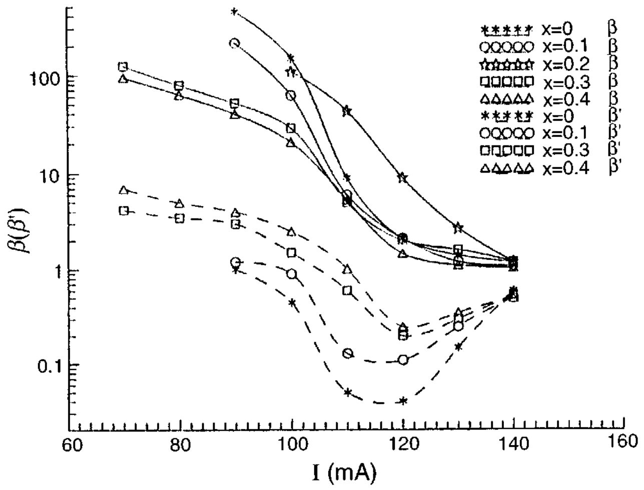

FIG. 2. Sensitivity $\beta(\beta = R_x/R_0)$ of $La_{1-x}Sr_xFeO_3$ ($x = 0$–0.4) to 100 ppm ethanol gas versus heating current and the resolution curves β' ($= \beta_{ethanol}/\beta_{gasoline}$) of $La_{1-x}Sr_xFeO_3$ ($x = 0.1$, 0.3, 0.4) gas sensors to 100 ppm ethanol, and 1000 ppm gasoline versus heating current I, where R_x is the resistance measured in a working circumstance, and R_0 the resistance measured in air.

of β, we note that although the sensitivity of the sensor to ethanol decreases by adding more Sr, but the sensitivity to gasoline decreases faster, so the resolution β' of ethanol to gasoline increases. We can see from the above discussion that, when using $La_{1-x}Sr_xFeO_3$ ($x = 0.1$, 0.3, 0.4) materials to detect ethanol, the working temperature may decrease. This will save the energy and improve the sensitivity and selectivity.

REFERENCES

1. P. K. Gaillagher and J. B. MacChesney, *Symp. Faraday Soc.* **1** 40 (1967).
2. T. Nitadon, M. Misono, *J. Catal.* **93,** 459 (1985).
3. J. Wu, *J. Transducer Tech.* **1,** 6 (1988).
4. H. Obayoshi, Y. Sakurai, and T. Gejo, *J. Solid State Chem.* **17,** 299 (1976)
5. R. Rirringer, H. Gieiter, H. P. Kiein, and P. Marguardt, *Phys. Lett. A* **102,** 365 (1984).
6. Z. Cui and Y. Sun, "Ultra Fine Particle," Northeast Univ. Press, Shenyang, 1988.
7. F. Wu, *Chem. J. Chinese Universities* **6,** 803 (1994).