SYNTHESIS AND PROPERTIES OF CuO:Fe NANOCRYSTALLINE FILMS

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For detection of noxious, explosive and flammable gases are widely used gas sensors based on semiconducting oxide nanostructures. Since, these nanomaterialials provides great advantages as low-cost production, simplicity of the final device structure, robustness in practical application, and adaptability to a wide variety of oxidizing and reducing gas atmospheres. It is well known that the doping of oxide nanostructures may change their response, sensitivity and selectivity for certain gas [1]. In this research, nanocrystalline films of Fe-doped CuO were synthesized from chemical solution (SCS) as described in our previous paper [2]. Samples were thermally processed in electrical furnace (TA) and rapid thermal processed (RTA) in order to control material properties and to investigate their influence on the gas sensing properties.

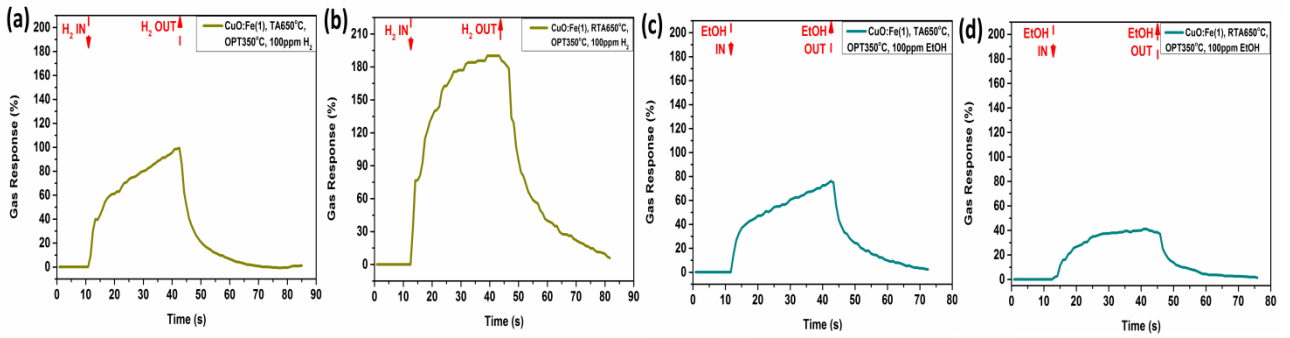

Figure 1 Dynamic gas response of Fe-doped CuO nanocrystalline films at 350°C operating temperature for samples treated: (a) TA at 650°C for 30 min (TA 650°C); and (b) RTA at 650 °C for 60 s (RTA 650°C) to 100 ppm of H_2; (c) TA 650°C and (d) RTA 650°C to 100 ppm of ethanol vapor ambient.

Figure 1 (a, b) shows the dynamic responses to 100 ppm H_2 of Fe-doped CuO nanocrystalline films at operating temperature 350°C, sample sets (a) and (b) were thermally processed TA 650°C and RTA 650°C. It can be observed that sensor based on nanocrystalline films treated TA 650°C posses a 99% response and response/recovery time are ~25 s and ~13 s, respectively. Sensor structures made from films treated RTA 650°C posses a response of 190% and response/recovery time are ~ 14 and 24 s, respectively. Results demonstrate that the RTA processing increases response twice, as well as it decreases the response time and increase recovery time.
Figure 1 (c, d) shows the dynamic response to 100 ppm of ethanol vapor of Fe-doped CuO nanocrystalline films at the same operating temperature and treated TA 650°C and RTA 650°C. In our experiments, for sensor structures based on films treated TA 650°C the response is 76% and response/recovery time are ~ 25.8 and 19.2 s, respectively, while for samples treated RTA 650°C the response is 41% and response/recovery time are ~ 12.9 and 14.4 s, respectively. Our experimental results indicates that rapid thermal treatment RTA allows to control CuO:Fe properties and in the case of ethanol vapor detection it decrease the response and improve rapidity of sensor structures. In conclusion, the RTA treatment allows to improve greatly selectivity of CuO:Fe nanocrystalline films to H_2 gas.

[1] N. Ababii, V. Postica, V. Cretu, S. Railean, V. Sontea, E. Monaico, O. Lupan. *ICTEI* (2015) 234-235.
[2] V. Creţu, V. Postica, N. Ababii, V. Trofim, V. Sontea, O. Lupan. *ICMCS* **8** (2014) 106-110.

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