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Fabrication of Zeolite Modified Cu Doped ZnO Films and Their Response towards Nitrogen Monoxide

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Abstract : Breath analysis represents a promising non-invasive, fast and cost-effective alternative to well-established diagnostic and monitoring techniques such as blood analysis, endoscopy, ultrasonic and tomographic monitoring. Portable, non-invasive, and low-cost breath analysis devices are becoming increasingly desirable for monitoring different diseases, especially asthma. Beacuse of this, NO gas sensing at low concentrations has attracted progressive attention for clinical analysis in asthma. Recently, nanomaterials based sensors are considered to be a promising clinical and laboratory diagnostic tool, because its large surface–to–volume ratio, controllable structure, easily tailored chemical and physical properties, which bring high sensitivity, fast dynamic processand even the increasing specificity. Among various nanomaterials, semiconducting metal oxides are extensively studied gas-sensing materials and are potential sensing elements for breathanalyzer due to their high sensitivity, simple design, low cost and good stability.The sensitivities of metal oxide semiconductor gas sensors can be enhanced by adding noble metals. Doping contents, distribution, and size of metallic or metal oxide catalysts are key parameters for enhancing gas selectivity as well as sensitivity. By manufacturing doping MOS structures, it is possible to develop more efficient sensor sensing layers. Zeolites are perhaps the most widely employed group of silicon-based nanoporous solids. Their well-defined pores of sub nanometric size have earned them the name of molecular sieves, meaning that operation in the size exclusion regime is possible by selecting, among over 170 structures available, the zeolite whose pores allow the pass of the desired molecule, while keeping larger molecules outside.In fact it is selective adsorption, rather than molecular sieving, the mechanism that explains most of the successful gas separations achieved with zeolite membranes. In view of their molecular sieving and selective adsorption properties, it is not surprising that zeolites have found use in a number of works dealing with gas sensing devices. In this study, the Cu doped ZnO nanostructure film was produced by SILAR method and investigated the NO gas sensing properties. To obtain the selectivity of the sample, the gases including CO,NH3,H2 and CH4 were detected to compare with NO. The maximum response is obtained at 85 C for 20 ppb NO gas. The sensor shows high response to NO gas. However, acceptable responses are calculated for CO and NH3 gases. Therefore, there are no responses obtain for H2 and CH4 gases. Enhanced to selectivity, Cu doped ZnO nanostructure film was coated with zeolite A thin film. It is found that the sample possess an acceptable response towards NO hardly respond to CO, NH3, H2 and CH4 at room temperature. This difference in the response can be expressed in terms of differences in the molecular structure, the dipole moment, strength of the electrostatic interaction and the dielectric constant. The as-synthesized thin film is considered to be one of the extremely promising candidate materials in electronic nose applications. This work is supported by The Scientific and Technological Research Council of Turkey (TUBİTAK) under Project No, 115M658 and Gazi University Scientific Research Fund under project no 05/2016-21.

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