CO sensing properties of Au-functionalized ZnO nanowires with self-heating effect

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Chemoresistive-type metal oxide semiconductor chemical sensors are superior to other types of chemical sensors, such as electrochemical, optical, and acoustic-based chemical sensors; these include their low-cost preparation, small size and ease of miniaturization, flexibility in mass production, and simple operation. Accordingly, metal oxide semiconductor gas sensors have been intensively studied. However, there are two critical drawbacks of semiconductor chemical sensors: First, their operating temperatures are typically between 100 and 400 °C. These high temperatures are needed to ensure high sensitivity, as well as response and recovery times short enough to be applied in actual sensor devices because these times are largely dependent on the nature of interactions and their kinetics during adsorption/desorption of analyte molecules onto/from surfaces of semiconducting sensor materials. Second, relatively weak selectivity is a problem.

These problems make convergence of mobile and portable devices difficult. In order to overcome these difficulties, we fabricated ZnO nanowires (NWs) functionalized with Au nanoparticles (NPs) and investigated their room temperature sensing properties. In this study, ZnO NWs, grown by VLS, were functionalized with different amount of Au NPs. The amount of Au NPs was controlled by changing the thickness of the sputter-deposited Au layers on ZnO NWs. After a thermal treatment, Au layers were disintegrated into isolated islands, resulting in functionalization of Au NPs on ZnO NWs. We have investigated the sensor optimization and selectivity according to the applied voltage. We confirmed that it is possible to develop a sensor with excellent selectivity for CO gas under a low applied voltage of 7V.