The Effect of Catalytic Metal Contact on Methane Sensing Performance of Nanoporous ZnO -Si Heterojunction

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Abstract- A sol-gel derived ZnO-p-Si heterojunction structure were fabricated and investigated as a potential methane sensor. Three configurations with different contacts (Pd-Ag contact both on ZnO and Si / Pd-Ag on ZnO side and Au on Si / and Au on both sides of the junction) were fabricated in order to study the impact of the catalytic contact on the methane sensing properties. Structural characterization with high resolution FESEM and EDX study revealed the synthesis of highly crystalline ZnO thin film with particle size ~40nm. The catalytic contact metal used was also of nanoporous nature as was revealed from FESEM were as the noncatalyic metal showed flake like texture. The heterojunctions were investigated at different operating temperatures (50^{o}C-300^{o}C) and at different operating voltages (1-5V) for varying concentrations of methane (0.1%, 0.5% and 1.0%). It was observed that the device with Pd-Ag (70%) contacts on both sides offered shorter response time (~28sec) and much higher response magnitude (~63%) compared to the sensor with Au contact both sides (response time ~47 sec and response magnitude ~ 19%). It is further revealed that the sensor performance with catalytic contact only to ZnO (and Au to Si) is almost the same as that of sensor having catalytic contact on both sides, emphasizing the fact that using catalytic contact to the sensing layer only modulates the sensor characteristics. The diode parameters like ideality factor, saturation current and the change in barrier height (upon exposure to methane) were also calculated for getting the insight of the sensing mechanism and were found to be in well agreement with the experimental results.

Keywords- Sol-gel, ZnO, Heterojunction devices, Methane sensor, Pd-Ag (70%) catalytic contact