Lung cancer is one of the most dangerous diseases worldwide. The early diagnosis of lung cancer in stage I can significantly increase the five-year survival rate of the patients. However, the symptom of early-stage lung cancer is not significant, while mass screening is difficult to carry out with traditional lung cancer screening methods. Early diagnosis of lung cancer by breath analysis is an easy and efficient method. In recent years, electronic nose (e-nose) has been developing quickly, especially in the medical field. Using e-nose for lung cancer diagnosis has become a hotspot for researchers. In this thesis, to realize the early diagnosis of lung cancer by breath analysis, semiconductor gas sensors made from different kinds of ZnO and modified ZnO designed for an e-nose were prepared. First, pure ZnO, we successfully synthesized ZnO nanoneedles by a simple hydrothermal method and studied the influence of the amount of surfactant and synthesis time on the structure and sensing performance of ZnO. The amount of CTAB showed significant influence to both the morphology and gas sensing performance. Considering all the factors, especially response/recovery times, the ZnO1 sensor is chosen as the best one. The Fe-doped ZnO nanoneedles were successfully doped with Fe by slowly adding $Fe(NO_3)_3$ into the precursor. The Fe doping changed the morphology of ZnO. With the increase of Fe amount, the ZnO needle became smaller and had a fishnet-like structure. The Fe-doped ZnO remains the n-type semiconductor property. The 5 at% Fe-doped ZnO showed the best sensing performance to isopropanol at 275°C. The response to 250 ppb isopropanol is 4.7, together with a fast response/recovery rate. For Co-ZnO sensors, two kinds of nanosheet-assembled flower of Co-ZnO sensors have been successfully synthesized through the same chemical deposition method by mixing Co^{2+}, Zn^{2+} and 2-methlyimidazole in water and adding ammonia. The state of Co changed with the amount of Co^{2+} added to the precursor. The gas sensing performance of the Co-ZnO sensors was tested with different kinds of VOCs as biomarkers of lung cancer. The effect of CO_2, relative humidity and VOCs contained in exhaled breath were taken into account as well. The Co substituted ZnO showed good response and long-term stability to isopropanol, while the sensors with Co_3O_4 were more sensitive to acetone. 10Co sensor showed a considerable response to isopropanol with the interference of CO_2 and other VOCs. 5 at% Na-doped ZnO was successfully prepared with the assist of citric acid. When the molar ratio of Na:citric acid was 3:1, the Na-ZnO sample showed the best gas-sensing performance. At the same time, a selectivity change with temperature was observed as well. At 225°C and 200°C, the NaZnO1 sensor showed excellent selectivity to HCOH. Last, MXene-ZnO hybrids were synthesized by a simple hydrothermal method. After the synthesis, the obtained MXene-ZnO were calcinated at 500°C to derive the $Ti_3C_2T_x$ to TiO_2. The gas sensing performance was tested with different VOCs contained in human breath and the sensors showed different optimal working temperatures and selectivity. The response of these sensors was not so high but the good signal-to-noise ratio ensured a relatively good result to low concentration VOCs. All the results we obtained indicated that these ZnO-based gas sensors are suitable for building an electronic nose for the diagnosis of lung cancer by breath analysis.