**Metal- Oxide Based Gas Sensors**

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The purpose of my research was to create and analyze sensors and their resistance to various substances, including oxygen, hydrogen, and alcohol. Oxygen is an oxidizing gas that takes some electrons from the semiconductor and causes the resistance to increase, while hydrogen and alcohol act as reducing agents that give electrons to the semiconductor and cause the resistance to decrease. Semiconductors are vital in this setup, because their conductivity increases with increasing temperature. Unlike conductors and insulators, semiconductors contain a space between the valence band and conduction band through which electrons can flow and generate energy.

To create more efficient gas sensors, different conditions were tested while manufacturing titanium dioxide nanotubes through the process of anodization. By changing the concentrations and types of the electrolyte solution and by adjusting the voltages that were applied to the titanium and platinum at the anodization setup, nanotubes of varying lengths and widths were created. I made samples of nanotubes by preparing and cleaning titanium sheets using distilled water and a micro solution, isopropanol, and acetone. I then attached titanium to a positive electrode and platinum to a negative electrode connected to a voltage source, and produced nanotubes on the surface of the titanium by applying 55 volts for four hours. After annealing the sample, I then used a sputtering machine to sprinkle platinum on the sample as a catalyst, and I placed it in the gas setup to establish contact with the sensor. After passing alcohol through the sensor, I found that the sensor is sensitive to alcohol. When I ran the sensor setup for 900 seconds, I found that the sensitivity value, or ratio, was 794.328. The sensitivity value of the same sample after a running time of 2500 seconds was much larger, at 31622.78. A larger and more constant sensitivity depicts an ideal sensor. The skewed data at the peaks of the second graph can be attributed to the fluctuation of temperature during the experiment. Additionally, in the alcohol breath test performed on drunk drivers, the DUI limit for Texas has been determined to range from 20 to 900 ppm. As shown in the first graph, ethanol was shown at 684 ppm. Because the sensor was sensitive to the alcohol in the range of 20-900 ppm, it can be applied to cases of determining alcohol levels during drunk driving.

By finding that the sensor is sensitive to alcohol, other experiments were also conducted, where other variables can be introduced and studied to facilitate further research. Determining the optimal thickness of the nanotube layer on the titanium foil helps improve conductivity during the gas experiment setup and this in turn increases the efficiency of the experiment. Further research can be done into nanotube formation and the resistivity of different gases to develop more efficient sensors that can detect various substances at wide ranges.

