THE EFFECT OF TIN IN Pt ELECTRODE FOR CO ELECTROCHEMICAL SENSORS

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Carbon monoxide (CO) is one of the major atmosphere pollutants mainly resulting from combustion of fuel in vehicles and power plants [1]. Carbon monoxide is among the toxic chemicals, which affect human health. Because of environment and safety concerns, governments have established laws and regulations to enforce air pollution control to ensure the health and safety of people.

In this report, an amperometric sensor was chosen to detecting the concentration of CO. In general, amperometry CO sensors use noble metal, such as gold, platinum and palladium [2,3] as the working electrode. In some sensors, porous catalytic platinum is deposited on Nafion®, which works as a solid electrolyte. However, there are several problems with Pt electrode, such as low sensitivity, poor selectivity and CO poisoning. Many researchers have spent efforts on increasing current in CO oxidation (e.g., fuel cell) or fundamental research by introducing second or third metals, such as Ru, Pb and Sn [4-6] etc. In the studying of amperometric CO sensors, we chose Sn metal to modify Pt electrodes.

Platinum catalyst was deposited from $Pt(NH_3)_4Cl_2$ on Nafion®117 (3.5 x 3.5 cm^2) by impregnation-reduction method. Tin modified platinum electrode for amperometric CO sensing has been developed.Four types of sensing electrodes in this research were fabricated: (1) Pt/Nafion® Electrode, (2) Pt_W/ Nafion®/Pt_C Assembly, (3) Sn/Pt/Nafion® Assembly, and Sn/Pt_W/Nafion®/Pt_C Assembly.

In this research, a tin modified Pt electrode was found to enhance the electroxidation of carbon monoxide with more negative potential, ie. the potential of limiting current of Sn/Pt/Nafion® electrode was 0.5 V (vs. Ag/AgCl), and which of Pt/Nafion® electrode was 0.8 V (vs. Ag/AgCl). For single Pt catalyst electrode system, the Sn/Pt/Nafion® electrode had better performance at CO sensing than non-modified Pt/Nafion® electrode. The sensitivity at the Sn/Pt/Nafion® electrode was 0.67 μA/ppm CO, about 6 times of that at the Pt/Nafion® electrode (0.12 μA/ppm CO) in the range of 0~400 ppm CO. The improvement in sensitivity was believed due to the oxidation mechanism shift from linear adsorption to bridge adsorption. And at the double Pt catalyst electrode, the tin modified Pt_W/Nafion®/Pt_C electrode also acted a better sensing behavior. The sensitivity of Sn/Pt_W/Nafion®/Pt_C was 0.38 μA/ppm CO, about 2 times of that at Pt_W/Nafion®/Pt_C electrode (0.137 μA/ppm CO). Besides, the operating potential was more negative at tin modified electrode, too.

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