

Making method of the Gas-Diffusion Electrode using Electrophoresis

Nagakazu Furuya

Department of Applied Chemistry, Faculty of Engineering, Yamanashi University, Takeda-4, Kofu 400-8511, Japan

Making method of the Gas diffusion electrode using electrophoresis phenomenon was reported to be made a cheap and high-performance electrode (1). The gas diffusion electrode is composed of a carbon black, a PTFE particles and a catalyst. It was noticed that carbon black and PTFE dispersion were dispersed using a non-ionic surfactant. Then, the zeta-potential of the dispersion is almost -30mV in pure water. The conductivity of the dispersion is under $100\mu\text{S/cm}$. If, the high voltage is applied between anode and cathode in the dispersion, the anode was covered with mixture of the carbon black and PTFE particles, that is, it was found that the carbon black and PTFE particles move to anode by the electrophoresis and then electrodeposited on the anode.

In this paper, the fundamental production technique on a gas supply layer of the gas diffusion electrode using by the electrophoresis phenomenon is reported.

The dispersion of the gas supply layer was composed by the hydrophobic carbon black (6%) and the PTFE dispersion (4%) in 4% Triton X-100 aqueous solution. The zeta-potential was analyzed at the ELS-6000 of the Otsuka Electronics Co., Ltd. The electrophoresis cell was made for oneself as shown Fig.1. The gas supply layer was deposited on Ag plate. The cathode is Ni mesh. The deposited area of the gas supply layer is 12.6cm^2 . The gap between the anode and the cathode is 15mm. The electrophoresis voltage were 10~100V/cm. The deposition time were 30~360 sec. The measurement of the composition was by the fluorescence X ray analysis (JSX-3201, JEOL).

The zeta-potential of the dispersion of the gas supply layer was negative value than -20mV in a 4% Triton X-100 aqueous solution. The average particle size is $0.4\mu\text{m}$. The conductivity of the dispersion was $69\mu\text{S/cm}$. It is proven that these particles have stably dispersed in aqueous solution and electrodeposition by the electrophoresis is possible on the anode. The dispersion of gas supply layer was deposited for various electrophoresis conditions. The adjustment of the conductivity of the dispersions was carried out by passing through the ion-exchange resin. The conductivity of the dispersions were 40~250 $\mu\text{S/cm}$.

The relation between the cell voltage and the current density at anode was shown in Fig. 2 using the basic dispersion. The current also increases, as the voltage rises. The current density decreases with the time. The quantity of electricity for various cell voltages was almost same. Figure 3 shows the relation between the cell voltage and the deposition quantity per coulomb. The maximum of the deposition rate existed at 60V/cm.

The gas supply layer using the dispersions of different conductivity were deposited on Ag plates at 60V/cm. Figure 4 shows the relation between the specific resistance of the dispersion and the deposition quantity per coulomb. The deposition quantity per coulomb was proportional to the cell voltage. The dispersion of high resistivity shows large current efficiency for deposition of the gas supply layer.

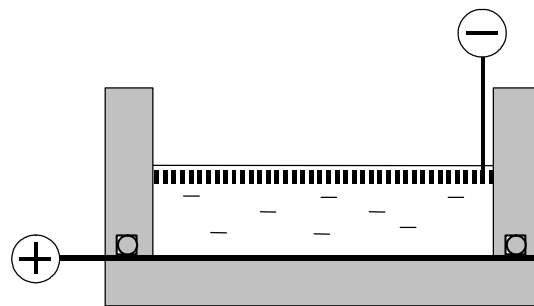


Fig.1 The schematic of the electrodeposition cell.

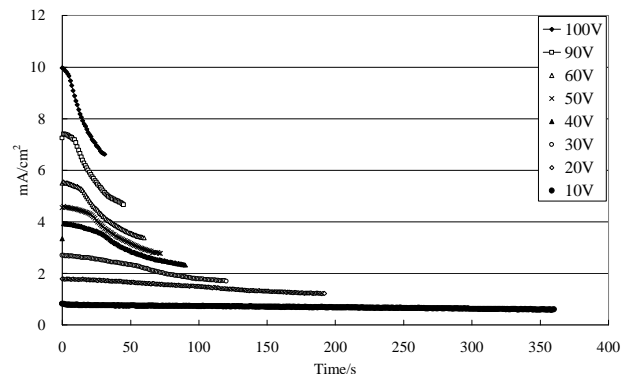


Fig. 2 Relation between the electrophoresis voltage and the current density.

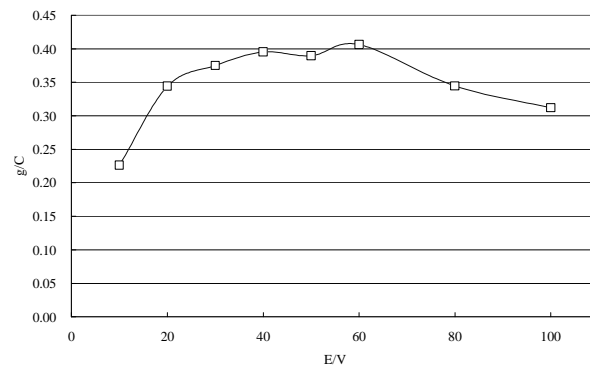


Fig. 3 Relation between the electrophoresis voltage and the deposition quantity per coulomb.

