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2. EXPERIMENTAL

Carbonaceous materials will be assembled to conduct glass to make capacitor electrode with simple sandwich type. Capacitor electrode was fabricated using simple sandwich method and made in 3 different varieties. This fabrication method was shown in fig.1. Carbon and active carbon paste was used in this material as a cell which size 20 x 15 mm. Capacitor is separated in two parts and electrolyte is used as a separator.

2.1 Carbonaceous material preparation

Carbon/active carbon powder was immersed in 15ml Titanium Iso-propoxide and 100ml 2-propanol for 1 hour, mixed by using magnetic stirrer. In this process, Carbon/active carbon powder of 0.4 g was added to this solution and 10~15 ml NH4OH+H2O (1:1) was added drop by drop under constant stirring until it turned to a sol at ambient condition. Then, in sol condition, carbon or active carbon was heated at 120°C in 2 hour to make a dried gel to perform sintering process. Sintering process is needed to obtain a very high purity of carbon/active carbon. Sintering temperature in carbon will analyzed with 450°C~520°C in 2 hour and it shown in Table 1. Particle sizes of carbon and active carbon were investigated by field emission scanning electron microscope.

In 1 gram dry carbon, 2 ml α-terpineol with 0.7 g ethyl cellulose was immersed in 100 ml Ethanol for 1 hour and put in ultrasonic cleaning. Then, using evaporation process, carbon/active carbon paste can be made in 8~10 min with 50°C~75°C in water heated chamber. The carbon paste, used for comparison, was prepared in exactly the same manner as that of the active carbon.

2.2 Carbonaceous materials assembly

The cells were doctor bladed onto conducting glass plates using a glass rod or a rod coater. The method is illustrated in fig. 2.

A cast frame was cut out of tape and it was laid over the glass substrate. Mold was made from rectangular aluminum pipe to achieve some consistency in the carbonaceous area. A pattern size of the cast (cell) was cut using a scalpel on a cardboard and the tapes were then laid on the cardboard and cut using the pre-cut pattern. Additional tapes were required to cover the sides of the glass to prevent the paste from staining the 25 x 45 mm sized glass. Paste was initially dispensed using a small spoon and aluminum pipe as a rod coater. After the paste was spread, conducting glass was left to dry for 5 minutes before the tapes were removed and then it left to dry at 70°C for 10 minutes. Capacitor electrode was made using two electrodes with carbon or active carbon, were attached together with electrolyte as a separator.

3. RESULTS AND DISCUSSION

The structural and physical characterization of capacitor electrode was characterized by X-ray diffraction techniques (XRD). Alpha step is used to know the carbon cell thickness which 4 carbon sample were analyzed with mean thickness 32
μm. Active carbon paste must have the same thickness with carbon because it used for comparison (thickness range 30-40 μm). High purity of carbon has become an important research to get the best sample. Carbon powder with 500°C sintering temperature in 2 hour is the better temperature to get the high purity of carbon and the better efficiency in discharge process. In fig. 3 which using XRD, it’s also shown the comparison in each sintering temperature.

![XRD patterns of carbon powders prepared by co-precipitation and calcined at 450°C-520°C. Carbon powders at 500°C show very sharp diffraction peaks and very broad diffraction lone, indicating good crystalline. It Carbons in general show a 002 diffraction maxima at 2θ - 25° and overlapped 100 and 101 maxima (usually identified as the 10 peak) at 2θ - 42°. The stack height Lc, of the graphitic micro-crystallites is determined by the width of the 002 peak. Carbon heated found that both diffraction peaks near 25 and 42° grow with the increase of heating temperature. They also proposed a geometric relationship between the microcrystalline structures and specific surface area of carbon.](image)

![Cyclic voltammetry as different electrode material was used to determine the electrochemical properties of electrode capacitor and thus to quantify the specific capacitance for each capacitor. Fig. 4 shows the cyclic voltammetry of carbon and active carbon as electrode for electrode capacitor. The electrode potential was scanned between -3.5 and 3.5 V at 50mV/s with different electrode material. The voltammogram shows a resolved peak at 2.645 V and -2.815 V in carbon-carbon electrode material, 3.415 V and -3.205 V in active carbon-carbon material and 3.48 V and -3.48 V. It can be seen that the two traces are almost similar. There is a drop in current peak between the electrodes from 3.258e-02 to 3.719e-02 for carbon material, from 1.325e-02 to 6.996e-03 for active carbon-carbon material and from 9.917e-03 to 8.785e-03 for active carbon material which increasing as the potential goes past the critical limit. In c-v characteristic, active carbon is more constant on the surface of the electrode then the other electrode material which then detaches from the electrode and allows the current to increase as a function of increased potential.](image)

In this work, electrode capacitor focused to be used as photo-capacitor. In principle, charging reaction is initiated by the light-induced charge separation of dye molecules at the hetero-junction interface and the electron injection from photo-excited dye molecules to the semiconductor conduction band following the mechanism of dye sensitization. Electron and holes of dye transfer to electrode capacitor which positive and negative charges will be accumulated on the microporous surface of carbon or active carbon. Fig. 5 exhibits photo-capacitor electrode behavior application in the discharge process and voltage decrease in the discharge process which a main component as DSCs was eliminated. The voltage approximately decreases in constant condition.

![Discharging characteristic photo-capacitor](image)

4. CONCLUSIONS

Photo-capacitor electrode using simple sandwich method works well with 20 mm x 15 mm size carbonaceous electrode material was analyzed with 3 different samples. Based on this experiment, simple sandwich capacitor 500°C sintering temperature in 2 hours has the highest purity of carbon and the most efficient in the discharge process which using sol-gel method with mean thickness in each type of capacitor is 32 μm. In c-v characteristic, active carbon is more constant on the surface of the electrode then the other electrode material which then detaches from the electrode and allows the current to increase as a function of increased potential.

[REFERENCES]