Capacitive Deionization Characteristics of Nanostructured Carbon Aerogel Electrodes

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The capacitive deionization (CDI) process is a simple, energy-efficient, and economical desalination process compared to the reverse osmosis (RO) or thermal distillation process. In particular, CDI process using highly porous and electrically conductive carbon aerogel electrodes have been evaluated as a novel technology for removing ionic species from aqueous solution [1-3].

In this work, effective carbon aerogel electrodes applicable to the capacitive deionization (CDI) process were synthesized via pyrolyzing RF (resorcinol-formaldehyde) organic aerogels which could be cost-effectively obtained by ambient-drying of RF wet gels and their characteristics were evaluated.

To prevent the cracking and destruction of large-sized RF wet gels caused by asymmetric drying stresses during ambient drying, the solvent exchanging time and evaporation rate were controlled very carefully. Ambiently dried RF aerogels were pyrolyzed at 800 ^{o}C in nitrogen atmosphere. Synthesized carbon aerogels have high surface area (~700 m^2/g), low density (~0.45 g/cm^3), high specific capacitance (~220 F/g), and low electrical resistivity (~0.03 Ω·cm).

The capacitive deionization (CDI) system using various stacks of carbon aerogel electrodes synthesized in this work was installed and its feasibility has been evaluated by the ion removal efficiency in the fixed amount of sodium chloride solution per unit weight of the carbon aerogel electrode. Fig. 1 shows a schematic diagram of CDI system used in this work. The monolithic plate (157 × 79 × 1 mm) of the carbon aerogel electrode is shown in Fig. 2. Fig. 3 shows the conductivity degradation versus operating time for 500 cc of 1.786×10^{-3} M sodium chloride solution with 100 μS/cm and 6.13 g of carbon aerogel under 1.2 V applied.

References

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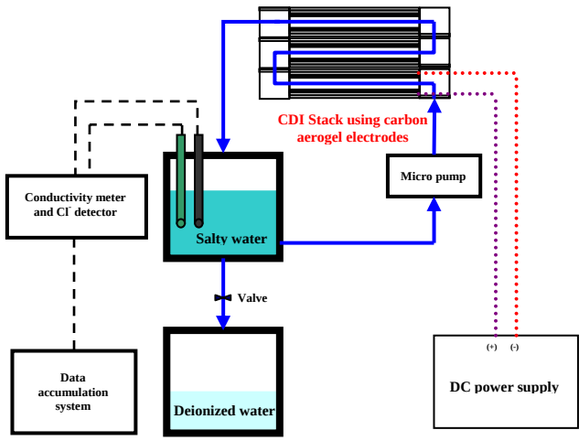

Fig. 1. Schematic diagram of capacitive deionization (CDI) system using carbon aerogel electrode stacks.

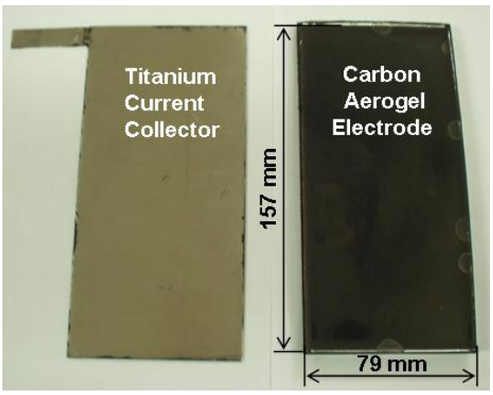

Fig. 2. Photograph of the titanium current collector and the large-sized carbon aerogel monolith electrode.

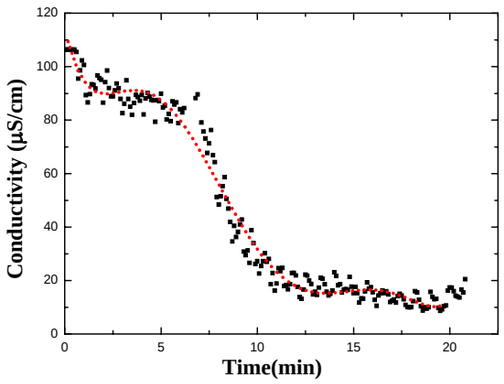

Fig. 3. Conductivity degradation depending on operating time under 1.2 V applied for 500 cc of 1.786×10^{-3} M sodium chloride solution and 6.13 g of carbon aerogel electrodes.