Physico-Chemical nanomaterials science

Electrodes based in carbon nanomaterials: structure, properties and application to capacitive deionization in static cell

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Porous structure and hydrophilic-hydrophobic properties of the electrodes, which are based on highly dispersive activated carbon of fibrous or corpuscular structure were researched using the method of standard contact porosimetry [1]. The size of pores is within a very wide range: from <1 nm up to 10^5 nm, nanopores make a great contribution into total porosity. In opposite to considerable part of micro- and macropores, the nanosized mesopores are mainly hydrophilic. Together with micropores, they are responsible for high hydrophilic specific surface area (420-850 $m^2\ g^{-1}$), the total surface area reaches 600-1520 $m^2\ g^{-1}$. The values of hydrophilic specific surface area are very important, since electrochemical processes are realized on the hydrophilic surface.

The values of electric double layer (EDL) capacitance, which were determined in $MgSO_4$, $CaCl_2$, $NaHCO_3$ solutions of different concentrations, are 9-26 F cm^{-2} relatively to hydrophilic surface. Capacitive deionization of water solutions was investigated in a static electrochemical cell, the original mathematical model for the charging-discharge processes was applied to the process. In opposite to known approaches, the model allows us to predict the results without theoretical calculations of the EDL capacitance. The model particularly takes into consideration charging-discharging of the EDL and surface conductivity[2], which are realized mainly in hydrophilic nanosized pores. The experimental and calculated data shows the highest degrees of desalination and electrode regeneration for the most hydrophilic carbon nanomaterial.

1. *Volfkovich Yu.M., Bagotzky V.S., Sosenkin V.E., Blinov I.A.* // Colloids Surf. A Physicochem. Eng. Asp. 2001. **187-188**. P. 349–365.

2. *Vol'fkovich Yu.M., Mikhalin A.A., Rychagov A.Y.* // Russ. J. Electrochem. 2013. **49**, N 6. P. 594–598.