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An electrochemical cell study on polyvinylpyrrolidone aqueous gel with glycol addition for capacitor applications

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Abstract

In order to improve a capacitor's energy density, an operative voltage extension is a simplest way. And, an organic gel usage, which has a more stabilized potential window than an aqueous gel. Based on these concepts, we have examined a two electrode symmetric electric double layer capacitor (EDLC) based on YECA activated carbon electrodes at 22°C using a gel electrolyte from polyvinylpyrrolidone (PVP) in ethylene glycol (EG) – water with sodium sulphate as a salt. Infrared spectroscopy has taken to confirm the electrolyte interactions. Cyclic Voltammetry (CV) results have shown the capacitor's reversibility and symmetric EDL. Linear sweep voltammetry (LSV) was used to determine a 2V applicability of the gel. From the AC impedance (EIS) result, the glycol has increased the cell resistance, but a low percentile of glycol did not show any magnificent changes on the aqueous gel based cell. Galvanostatic cycling (CD) test also performed which evidences an improvement in the low rate aqueous gel based cell and its voltage limit. A typical specific capacitance, real power and energy density of the cell with 10% replacement of water by glycol were  $\sim 21 \text{ F.g}^{-1}$ ,  $0.7 \text{ kW.kg}^{-1}$  and  $11 \text{ Wh.kg}^{-1}$  of respectively which is significantly higher than the aqua gel based cell ( $\sim 22 \text{ F.g}^{-1}$ ,  $0.55 \text{ kW.kg}^{-1}$  and  $6 \text{ Wh.kg}^{-1}$ ).

**Keywords:** supercapacitor, sodium salt, aqueous polyvinylpyrrolidone gel, activated carbon, ethylene glycol,

\*present

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