

# ELECTROLYTES FOR THE ELECTROCHEMICAL SUPERCAPACITORS

J. Kněžínek<sup>1</sup>, M. Kocian<sup>1</sup>, J. Vondrák<sup>2</sup>, M. Sedlaříková<sup>1</sup>

<sup>1</sup> *Institute of Electrotechnology, Faculty of Electrical Engineering and Communication Technologies, Brno Technical University*

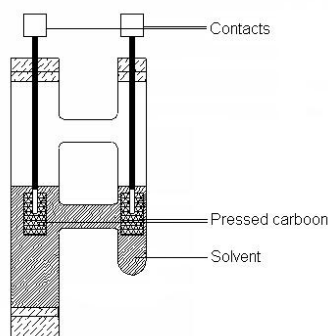
<sup>2</sup> *Institute of Inorganic Chemistry, Academy of Sciences of Czech Republic*

## Introduction

This work deals with the selection of electrolytes and additives and their ratio for the development of electrode for electrochemical supercapacitor.

## Experimental

Two identical electrodes (carbon deposited on metallic screen) are put against each other and between them are measured different liquid electrolytes (Fig. 1). are used: Propylene carbonate 99% (PC), Propylene carbonate 99.7%, formamide, dimethylformamide (DMF) and dimethylsulfoxide (DMSO) are used as solvents. 2.66 g of anhydrous LiClO<sub>4</sub> is added to 50 ml solvent, thus 0.5M solution is formed. This electrolyte is placed in the glass cell (see Fig. 1)



**Fig. 1** Glass cell for measurements with liquid electrolytes

Experiments were performed by programme GPES in AUTOLAB PGSTAT 12 – cyclic voltammetry (Fig.2).

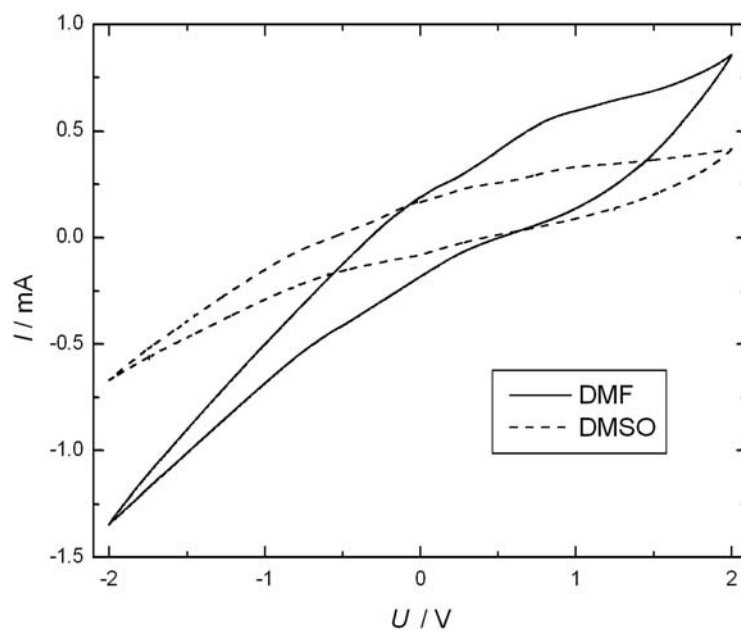
---

Corresponding author:

Martin Kocian

+420 54114 6170, +420 54114 6147

E-mail: xkocia03@stud.feec.vutbr.cz



**Fig. 2** Cyclic voltammetry of 0.5M  $\text{LiClO}_4$  solutions in *N,N*-dimethylformamide and dimethylsulfoxide

**Table 1** Results of liquid electrolytes

Solvent	Voltage range (V)	Scan rate ( $\text{V}\cdot\text{s}^{-1}$ )	Capacity for 0 V (mF)
propylene carbonate 99%	-2 – +2	0.01	3.758
propylene carbonate 99.7%			8.025
formamide			7.370
<i>N,N</i> -dimethylformamide			18.565
dimethylsulfoxide			12.336

The capacity is calculated from the formula:

$$C = \frac{1}{2} \cdot \frac{\Delta I}{\alpha} \quad (1)$$

where  $C$  (F) is capacity,  $\Delta i$  (A) is difference of currents at anodic and cathodic branches and  $\alpha$  ( $\text{V}\cdot\text{s}^{-1}$ ) is the scan rate (for this measurement  $0.01 \text{ V}\cdot\text{s}^{-1}$ ).

**Table 2** Attributes of used solvents

Solvent	Formula	Melting point (°C)	Boiling point (°C)	Relative Permittivity	Viscosity (cP)	Density (kg.m <sup>-3</sup> )
DMF	HCON(CH <sub>3</sub> ) <sub>2</sub>	- 61	158	36.7	0.796	944,6
PC	C <sub>4</sub> H <sub>6</sub> O <sub>3</sub>	- 55	241	64.4	25.3	1190
DMSO	(CH <sub>3</sub> ) <sub>2</sub> SO	19	189	46.6	1.96	1096

## Conclusion

0.5 mol.l<sup>-1</sup> solution of lithium perchlorate in N,N-dimethylformamide is the best liquid electrolyte of measured electrolytes.

The capacity 8.025 mF was reached with 99.7 % propylene carbonate and 3.758 mF with 99 % propylene carbonate. This result verifies fact that 99.7 % propylene carbonate is more suitable than 99 % propylene carbonate for our measurement. This result indicates the importance of solvent purity.

## Acknowledgments

This work was supported by the Grant Agency of the Academy of Sciences of Czech Republic (Grant No. B4813302) and by the Grant Agency of Czech Republic (Grant No. 104/02/0731).