**Towards Understanding the Interfacial Phenomena in Electrochemical Capacitors with *Operando* Techniques**

**Krzysztof Fic, Jakub Menzel, Anetta Płatek, Justyna Piwek, Przemysław Galek, Adam Ślesiński, Paulina Bujewska, Elzbieta Frackowiak**

*Poznan University of Technology, Institute of Chemistry and Technical Electrochemistry, Berdychowo 4, 60965 Poznan, Poland*

Email: krzysztof.fic@put.poznan.pl

This paper will provide comprehensive insight on the application of the *in-situ* and *operando* techniques such as Raman spectroscopy, Quartz Crystal Microbalance (EQCM), Scanning Electrochemical Microscopy (SECM), On-line Electrochemical Mass Spectroscopy (OEMS) and Operando Contact Angle Measurements (oCAM). These techniques were applied for determination of charge storage phenomena and ageing factors in activated carbon-based supercapacitors, operating with aqueous electrolytes.

It has been already confirmed with *in-situ* Raman spectroscopy that activated carbon electrodes operating in neutral aqueous media like Li2SO4 or LiNO3 solutions are prone to a mild oxidation during cycling (vibration modes from oxygen-based functionalities found) whereas the surface chemistry of negative electrode appears to be unchanged. EQCM study confirmed significant frequency/mass variation of the positive electrode. However, SECM demonstrated that during positive and negative polarization, the thickness (and volume) of the negative electrode changes remarkably, even within the typical capacitive storage range. This might be related with the specific adsorption of the solvated Li+ specimen. Interestingly, oCAM indicated that the hydrophobic/hydrophilic properties of activated carbon surface change with the polarization direction and potential values. OEMS confirmed that for more hydrophilic surfaces, more CO and CO2 gases should be expected at elevated voltages. It has been also shown that redox-active electrolytes (e.g. solutions of alkali metal iodides, bromides, thiocyanates) might have a detrimental impact on the carbon electrode performance. An oxidation of carbon surface has been identified near the iodide/iodine redox activity potentials, being even more pronounced for bromide-based systems. While EQCM study confirmed the presence of various iodine species in the electrolyte, carbon ‘corrosion’ has been observed especially for more concentrated iodide solutions.

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**Krzysztof Fic** graduated in Chemical Process Engineering at the Faculty of Chemical Technology, Poznan University of Technology. Since August 2019, he serves also as a ‘Specially Appointed Professor’ at Kansai University in Osaka (Japan). His research activities are focused mainly on the electrochemical systems for the energy conversion and storage, in particular on phenomena occurring at the electrode/electrolyte interface.

Krzysztof Fic is the co-author of more than 50 papers indexed in ISI Master Journal List. His H-index is 20, and citation number approaches 2000 records.

He is also co-author of 12 patents and 21 patent applications.

In 2009-2020, he presented 49 oral communications and 14 posters during national and international conferences, in Europe, Israel, U.S., Mexico, Brazil, Japan, South Korea, Hong Kong, China, Taiwan and Australia. A number of oral communications and posters he has co-authored is even greater.

Krzysztof Fic is an active member of national and international organizations including the Polish Carbon Society, the International Society of Electrochemistry, American Chemical Society, the Electrochemical Society and Material Research Society. Besides, he served as Associate Editor of the "Central European Journal of Chemistry" until June 2012.

In 2016 he has been selected as a Member for Polish Young Academy at Polish Academy of Sciences. In September 2017 he has been awarded by European Research Council by receiving Starting Grant.