Supercapacitors based on well decomposed peat derived carbon electrodes using $ZnCl_2$ activation step for the carbon synthesis

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$ZnCl_2$ activation method was used to synthesize micro- and mesoporous carbon material from Estonian well decomposed peat. Our workgroup preliminary data for Estonian well decomposed peat derived carbon (PDC) based supercapacitorss demonstrated that the amount of mesopores icarbon particles was very low and therefore, an activation method was used, using $ZnCl_2$ as an activator. Chemical activation is considered an effective method for increasing porosity of carbonaceous materials.[1,2]

The synthesized material has S_{BET} value of 1270 m^2 g^{-1}, compared to the S_{BET} value of 270 m^2 g^{-1} without the activation step. The comparative pore size distribution data (Figure 1a) show that in addition to micropores, a very big amount of mesopores have been formed after the $ZnCl_2$ activation step, inevitable for quick mass-transfer processes of ionic liquid ions.[3]

The material was tested as an electrode material in a supercapacitor cell with ionic liquid $EmimBF_4$ as an electrolyte. The cyclic voltammetry, impedance spectroscopy and constant current charge/discharge cycles data show that the material is useable for stationary electricity storage in local small-scale wind farms and local PV electricity generating fields. The characteristic time constant (τ_R) of the PDC|$EmimBF_4$ is 3.35 s and is longer than for micro-mesoporous sol–gel titanium carbide derived carbon τ_R = 0.80 s, but is shorter than for activated sucrose derived carbon (τ_R = 20 s) and carbon cloth (τ_R = 8 s), thus, the τ_R correlates very well with the micro-mesoporosity ratio of carbons under systematic studies at University of Tartu.[4-6] The constant power test data show that very high energy densities E = 50 Wh kg^{-1} at moderate power densities P = 10 kW kg^{-1} can be achieved (Figure 1b).[3]

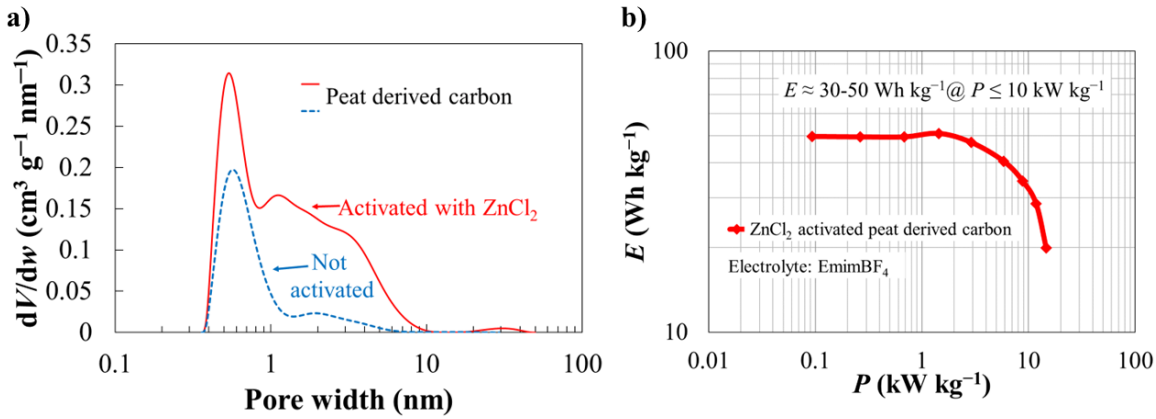

Figure 1. Pore size distribution for peat derived carbon activated with $ZnCl_2$ and not activated peat derived carbon (a) gravimetric Ragone plot for supercapacitors based on activated PDC|$EmimBF_4$ (b).

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