

years since 1992, there has been intense activity both in University research, and by financial support from State Ministries in the production of electric vehicles, chargers (particularly fast-chargers) and monitoring devices for accumulators. Legislative support has started in some cities.

References

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Microporous carbons for supercapacitors[☆]

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Due to the availability of various precursors and technologically well-developed methods of modification, materials based on carbon are especially adapted for application in electrochemical capacitors. They can be used with aqueous solutions (basic and acidic) as well as in aprotic media. During the preparation of carbon material it is possible, over a wide range, to affect the microtexture and chemical composition through the selection of precursor, conditions of carbonisation and the activation process.

The method used to prepare the carbon determines the electrochemical parameters of a capacitor. Generally, the most convenient is to use carbon materials in the fibrous form, however in our case the powdered carbon obtained from petroleum coke and then chemically activated supplied high capacitance values of over 200 F g⁻¹. Specific surface area of this carbon, as measured by nitrogen gas adsorption at 77 K, was approximately 2800 m² g⁻¹.

Electrochemical parameters of the investigated material, which was in the form of a pellet comprising 85% of C, 10% of PVDF and 5% of AB, were determined in the two electrode 'swagelok' cell as described elsewhere

[Frackowiak et al., Appl. Phys. Lett. 77 (2000) 2421–2423] using 6 M KOH and 1 M H₂SO₄ electrolytes. Specific capacitance was calculated from voltammetry characteristics at scan rates from 1 to 10 mV s⁻¹, galvanostatic cycling with current densities from 50 to 1000 mA g⁻¹ and impedance spectroscopy in the range from 1 mHz to 100 kHz. Electrochemical investigations were carried out using a multichannel potentiostat/galvanostat (VMP Biologic, France) and a Solartron SI 1260. All the techniques gave comparable results of specific capacitance of carbon (approximately 270 F g⁻¹ in alkaline solution and approximately 230 F g⁻¹ in acidic medium).

The results obtained show that alkaline electrolyte is preferable for this type of carbon when used as capacitor material. During voltammetry experiments from 0 to 0.8 V, the shape of the characteristics remains perfectly rectangular even at the fast scan rates (10 mV s⁻¹). Only in the wider range of potential (from 0 to 1.0 V) does the shape of voltammograms change slightly, but the stored charge remains the same and galvanostatic characteristics are still linear. This means that carbon material allows quick charge propagation. This is also confirmed by impedance spectroscopy (material supplies a high capacitance of over 120 F g⁻¹ at 1 Hz). This is a proof that the carbon material, apart from having a well-developed surface area, possesses the required porosity from the presence of mesopores. In acidic solution, the capacitance values are lower by about 20%, however the frequency response is better. Further investigations are planned to correlate microtexture, pore size, distribution of pores and chemical composition of carbon with capacitance parameters for aqueous as well as aprotic electrolyte solutions.

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Lead film electrodes as both negative and positive plates of a lead-acid battery

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As has been shown previously, the electrochemical characteristics of lead film electrodes may be significantly influenced by the materials and shape of metallic substrates. Lead layers were deposited by the currentless, contact-exchange method from a molten salt electrolyte onto pure and technical grade smooth aluminium plates and grids 300–700 μm thick and onto copper grids 100–150 μm thick.

As lead and aluminium (or copper) are practically mutually insoluble at temperatures up to 1000 K, the covering thus obtained consists of pure continuous lead. The lead film varies much in thickness at a number of points over the specimen, but pores never reach through to the aluminium base. The minimum thickness of covering is no less than 80 μm .

Because of the special features of this method of lead plating, the lead covering has a highly developed surface. Thus, the actual surface area of a lead film electrode can be 10 times as great as the apparent one. Lead coating of similar quality was also produced on coarse grids made from technical grade aluminium (99% Al) and aluminium alloys, which have much more prospects as constructive materials because of their better mechanical strength as compared to pure aluminium.

The electrochemical measurements of entirely immersed lead/aluminium electrodes were performed in a standard electrochemical cell under argon atmosphere. A silver chloride electrode (Ag/AgCl/saturated KCl solution) served as reference. ‘Extra pure’ grade 29 and 32 wt.% H_2SO_4 was used as electrolyte. Cycling of lead film electrode over the range 0.7–2.0 V was carried out under potentiodynamic conditions with a linear scanning rate of 10 mV s^{-1} and holding time of 200 s at the potential limits. The discharge current peak occurs at the potential of 1.5 V for the electrode on the aluminium plate. For an electrode on the aluminium substrate, the minimum value of the peak current density was observed during the first two cycles because of formation of a lead dioxide layer.

The peak discharge current increases up to the sixth cycle and then remains constant during the next 700 cycles. In some instances, the scanning voltammetry was stopped after 300 cycles and the working electrode was left to stand in sulphuric acid solution for 24–72 h. Only during the first cycle after this rest time was the magnitude of current discharge peak low. It then increased and attained its former value. Similar electrochemical behaviour was observed for the lead film electrode on the copper substrate.

It was shown that by exchanging the aluminium plate by a fine grid increases the value of current discharge peak by three–five times. In the case of lead plating onto a thin aluminium grid, we obtained a current density of 350–500 mA cm^{-2} . This value is even higher than that obtained from an electrode on a fine copper grid. During prolonged testing, bulking and scaling of the lead coating was never observed.

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Effect of sulfur and oxygen on the corrosion of stainless steel when in a fuel cell carbonate electrolyte

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We have investigated the effect of the corrosion on the steel, 12Cr18Ni10Ti by artificially injecting sulfur-, halogen- and oxygen-containing compounds of sodium into the high-temperature carbonate electrolyte of a fuel cell.

Corrosion resistance of the steel in a carbonate electrolyte has a significant role in the successful realisation of high-temperature devices.

At 873–1073 K, under an atmosphere of carbon dioxide and oxygen (2/1) or under atmospheric air, the interaction of the alkali carbonate melt (carbonates of lithium, sodium, potassium) with steel samples took place in a three-electrode cell with a special port for adding of salts, both when the cell was on open circuit and when it was under anodic potentiostatic polarization. The counter electrode was platinum wire, the reference one was the oxygen-carbonate electrode.

Addition of 2 mol% of sodium peroxide causes a significant shift of the corrosion potential into the electropositive region, with some growth of corrosion rate due to expansion of the thickness of the protective layers. There is a parabolic dependence of the corrosion rate during the steel sample's exposure in the melt.

At high temperature, the introduction of the peroxide into the salt phase resulted in the emergence of different oxygen ions and a layer with a higher oxygen content.

Under anodic polarization, the current density is lower than without excess oxygen, but the magnitude of the passive region does not change. Addition of 2 mol% of sodium halides causes a shift in the corrosion potential of about 0.1 V. Corrosion rate grows with increase of temperature.

Injection of sodium sulfide and sulfate has considerable effect on corrosion processes, both during polarization and on open circuit.

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