Electrochemical Properties of Mesoporous γ-Fe_2O_3

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Mesoporous γ-Fe_2O_3 was obtained by thermal decomposition of iron citrate xerogel hydrate synthesized by iron nitrate and citrate acid solutions with 0.3 M molar concentration. Amorphous iron citrate xerogel hydrate calcination in temperature 200°C within 1.5 hours causes the formation of mesoporous γ-Fe_2O_3 with coherent scattering region (CSR) sizes about 7-9 nm. CSR sizes were determined by Debye-Scherer formula. The specific surface area of obtained mesoporous γ-Fe_2O_3 is 164 m^2/g. Dependences of the pores volume on pores size for both series for all temperatures are characterized by a peak at 5 nm.

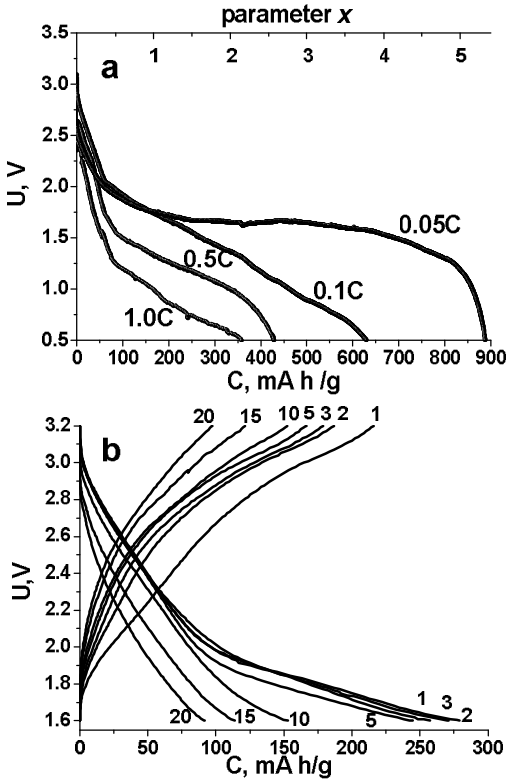

Fig.1

Mesoporous γ-Fe_2O_3 was tested as cathode material for lithium power sources (LPS). The cathodes were prepared from a mixture of obtained sample, acetylene black and PVdF with weight ratio of 80:15:5. The anodes were lithium metal and 1M $LiBF_4$ in γ-butyrolactone was used as the electrolyte. The charge and discharge tests were performed at 0.05C, 0.1C, 0.5C, 1.0C rates. Discharge curves of LPS with cathodes based on mesoporous γ-Fe_2O_3 at different current rates are shown in Fig. 1, a. Maximum values of specific capacity is 890 mA·h/g at a discharge current 0.05C. The increase of the discharge current leads to the specific capacity reduction: specific capacity is 360 mA·h/g at a discharge current 1.0C.

Mesoporous γ-Fe_2O_3 was tested at galvanostatic process charge / discharge. 20 cycles of charge / discharge was carried out at a current density of 0.1 C in the voltage range of 3,2 V - 1.6V (Fig. 1, b). Specific capacitance discharge for several initial cycles varies little within 250 mA·h / g. A sharp decrease in the maximum specific discharge capacity of the material occurs after the fifth cycle, which, after the twentieth cycle is 93 mA·h / g. Coulomb efficiency of the charge / discharge depends nonlinearly on the cycle number and getting the maximum value of approximately 57% for the 3rd cycle.