Nanocomposites and Nanomaterials

Electrochemical behavior of nanocomposite TiO_2/C in aqueous KOH

Budzulyak I.M., Hemiy O.M., Shyyko L.O.

Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine

E-mail: ivan_budzulyak@rambler.ru

Requirements for electrode materials for new sources and energystorage devices, encourage both to modificate already existing materials and to find new ones with high performance characteristics. The way to solve these problems, that are already known for today, is to apply the current conductive additives. However, the direct mechanical mixing of an electrode material components does not solve the another problem, which is a coagulation of nanoparticles within nanosize electrode material.

For electrochemical studies we prepared two parts of composite samples C/TiO_2. The content of TiO_2 within samples was 10, 20, and 30%, respectively. We used TiO_2 nanoparticles of anatase structure with size of 8-10 nm. The second part of composite samples was pre-irradiated by YAG-laser pulses (τ_i = 15 ns, E = 0,04 J, repetition rate f = 54 Hz). Selecting mode of laser irradiation was experimentally optimized based on the electrochemical properties of TiO_2 [1].

Composites were heated in an argon atmosphere with the rate of 10^0C/min at the temperature of 800^0C for 5 min. Obtained material was naturaly cooled and used as an electrode material in a three-electrode electrochemical cell. Obtained energy parameters of composites are shown in Table 1.

Table1

Parameters of composition materials

Sample		C, F/g
original	C/TiO_2 (70/30)	5,8
	C/TiO_2 (80/20)	20,9
	C/TiO_2 (90/10)	47,2
laser irradiated	C/TiO_2 (70/30)	65,0
	C/TiO_2 (80/20)	79,3
	C/TiO_2 (90/10)	105,9

Analysis of the results indicates that the main characteristics, which are internal resistance and specific capacity, strongly depend on the composition of the composite, conditions and laser radiation modes. In particular, as it is shown in Table 1, the electrochemical system formed from laser irradiated composite exhibits higher specific capacity than the original composite at a current of 1 mA. This is due to a significant increase in guest positions under laser irradiation and their alteration as a result of the structure transformation of TiO_2. Poor coordination of titanium and oxygen atoms leads to fluctuations of the angles and bond lengths of O-Ti-O dihedral angles of the oxygen octahedra and their mutual arrangement in the dioxin titanium. These changes are most likely due to the appearance of thermoelastic stresses within the surface layer caused by thermal action of laser radiation. These changes in the defects system significantly affect the energy and charge state of the guest positions and the sizes of the respective channels [2].

1. *Б.К.Остафійчук, И.М. Будзуляк, Р.В. Ильницкий, М.Я.Сегин, Л.С.Яблонь* Влияние лазерного облучения на электрохимическую активность TiO_2// Электрохимическая энергетика. – 2010. – Т.10 № 3. – С.116-121.

2. *І.Ф.Миронюк, В.В.Лобанов, Б.К.Остафійчук* Електронна структура й властивості діоксину титану, інтеркальованого металевим літієм // Фізика і хімія твердого тіла. – 2001. – Т.2, № 2. – С.493-499.