THE INTERNATIONAL SUMMER SCHOOL NANOTECHNOLOGY: FROM FUNDAMENTAL RESEARCH TO INNOVATIONS

and

INTERNATIONAL RESEARCH AND PRACTICE CONFERENCE "NANOTECHNOLOGY AND NANOMATERIALS" (NANO-2014)

23 -30 AUGUST 2014

YAREMCHE–LVIV, UKRAINE

BOOK OF ABSTRACTS

Compositional material based on pyrolytic carbon and copper nanoparticles

Mandzyuk V. I., Myronyuk I. F., Lisovskyy R. P., Sachko V. M.

Vasyl Stefanyk Precarpathian National University,
57, Shevchenko Str., Ivano-Frankivsk 76018, Ukraine.
E-mail: mandzyuk_vova@rambler.ru

The paper studied the porous structure and electrical conductivity of the composite material obtained from pyrolytic carbon and 1÷10 wt. % of copper nanoparticles. Disaccharide $C_{12}H_{22}O_{11}$ and $CuCl_2$ salt were used as a feedstock to produce a compositional material. The process of material obtaining included the dissolution of disaccharide and $CuCl_2$ in water, heating the solution at a temperature of 160÷180 °C for 0,5 h for the realization of carbohydrate precursor caramelization and reduction of Cu^{2+} ions to Cu^0 ones. Composite material carbonized at a temperature of 270÷300 °C further is annealed in protective atmosphere at 800 °C for 0,5 h. The feature of carbonization stage is that all carbon atoms in disaccharide moving into solid phase and do not form volatile compounds with oxygen atoms.

Structural and morphological parameters of the composite material were measured by means of nitrogen adsorption/desorption isotherms at a temperature of 77 K with the automated sorptometer Quantachrome Autosorb (Nova 2200e). The electrical conductivity of the material was measured in amplitude-frequency analyzer Autolab/FRA-2 (Holland) in the frequency range of 10^{-3}÷10^5 Hz.

The parameters of material shown in Table 1 indicate that the increase in the content of copper nanoparticles in the composite leads to an increase in the mesopore volume (V_{meso}) and specific surface area of the material (S_{sp}). However, the presence of copper nanoparticles in the material leads to a significant decrease in its conductivity, which requires further researches.

Table 1

Conductive and morphologic parameters of compositional materials

Standard	σ, $Ohm^{-1}\cdot m^{-1}$	S_{sp}, m^2/g	S_{micro}, m^2/g	S_{meso}, m^2/g	V, cm^3/g	V_{micro}, cm^3/g	V_{meso}, cm^3/g	d_p, nm
C	42.5	135	85	50	0.083	0.037	0.046	2.5
C+1%Cu	$1.42\cdot10^{-3}$	221	132	89	0.147	0.055	0.092	2.7
C+10%Cu	$4.73\cdot10^{-3}$	318	198	120	0.185	0.071	0.114	2.3

The carbon-copper composite can be applied as an electrode material in electrochemical power sources.

Sorption of Ag (I) ions by SH-functionalized planar ceramic membranes

Tomina V. V., Stolyarchuk N. V., Melnyk I. V., Kochkodan V. M., Zub Yu. L.

O. O. Chuiko Institute of Surface Chemistry of the NAS of Ukraine,
17, General Naumov Str., Kyiv 03164, Ukraine.
E-mail: melnyk@isc.gov.ua, v.v.tomina@mail.ru

The application of inorganic membranes for selective adsorption removal of heavy metals and radionuclides from waste and surface water is of particular interest. From this perspective, researchers got interested in the techniques of preparing such membranes using sol-gel method to create nanolayers of silica with three-dimensional ordered pore system. Such membranes were suggested to use in separation technology, catalysis and optical technologies [1–3].

In the current research sol-gel method based on the reaction of hydrolytic copolycondensation of tetraethoxysilane (TEOS) or 1,2-bis(triethoxysilyl)ethane (BTESE) with 3-mercaptopropyltrimethoxysilane (MPTMS) was used to functionalize ceramic membranes with α $\equiv Si(CH_2)_3SH$ groups. According to SEM, there is observed the formation of active layers of about 0,5 μm thick and composed of SH-containing nanoparticles 60–70 nm in diameter, the gaps between which determine their porosity. According to filtration studies in Amicon Stirred Ultrafiltration Cell using model Ag(I) nitrate solutions, the behavior of the membrane functionalized with BTESE acting as a structuring agent in the separation process depends on the degree of functionalization, with sorption separation mechanism prevailing at low functionalization degree (72,2 μg/cm²) and steric membrane mechanism of Ag(I) removal at higher degree of functionalization (505,7 μg/cm²). Whereas for the samples modified with TEOS acting as a structuring agent, steric membrane mechanism dominates.

Authors are grateful to NATO Science for Peace Program SPS.NUKR.SFP 984398 and the project of SFFR of Ukraine with BSFFR (Belarus) for the financial support of the work.

1. *Das N., Maiti H. S.* Ceramic membrane by tape casting and sol-gel coating for microfiltration and ultrafiltration application // J. Phys. Chem. Solids., 2009. – **70**. – P. 1395–1400.

2. *Xia Y., Gates B., Yin Y., Lu Y.* Monodispersed Colloidal Spheres: Old Materials with New Applications // Adv. Mater., 2000. – **12**. – P. 693–713.

3. *Velev O. D., Kaler E. W.* Structured Porous Materials via Colloidal Crystal Templating: From Inorganic Oxides to Metals // Adv. Mater., 2000. – **12**. – P. 531–534.