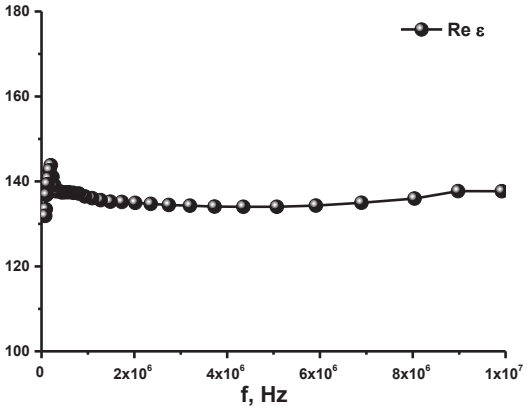

Рисунок 4 – Спектры диэлектрической проницаемости и тангенса угла диэлектрических потерь керамики $La_{1,8}Ca_{0,2}Ni_{1,8}Co_{0,2}O_4$

Керамика $La_{1,8}Ca_{0,2}Ni_{1,8}Co_{0,2}O_4$ характеризуется значением вещественной части комплексной диэлектрической проницаемости Re ε~140 и тангенса угла диэлектрических потерь tg δ ~ 0-40, почти не зависящим от частоты электрического поля в интервале от 10^3 до 10^7 Гц.

Таким образом, можно сделать вывод, что был получен газоплотный образец, состава $La_{1,8}Ca_{0,2}Ni_{1,8}Co_{0,2}O_4$, Данная керамика представляет собой реальный диэлектрик с утечкой. Значение диэлектрической проницаемости имеет довольно высокое значение порядка 10^2.

Работа выполнена при финансовой поддержке Государственного плана ИХТТ УрО РАН (№ АААА-А16-116122810209-5).

ЛИТЕРАТУРА

1. *Chen-Yang Shi* Structural, magnetic and dielectric properties of $La_{2-x}Ca_xNiO_{4+\delta}$ (x = 0, 0.1, 0.2, 0.3) / Zhong-Bo Hu, Yong-Mei Hao. – Journal of Alloys and Compounds. – 2011. – V. 509. – P. 1333-1337.

2. *Chupakhina T. I.* New Ways to Synthesize Multifunctional Ceramics $La_{2-x}Sr_xNiO_4$ / Gyrdasova O. I., Vladimirova E. V., Samigullina R. F. – ЖНХ. – 2015. – Т. 60. – № 10. – С. 1299–1307.

3. *Chupakhina T.I.* Synthesis, structural characteristics and dielectric properties of a new K_2NiF_4-type phase $Sr_2Mn_{0.5}Ti_{0.5}O_4$ / Melnikova N.V., Gyrdasova O.I. – J. Alloys Compd. – 2016. – V.670. – P. 105-112.

UDC 544.77.051; 553.9.15; 664.8.014/019

V.I. Vorobyova[1], PhD,
M.I. Skiba[2], PhD
[1]National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute, Kiev
[2]Ukrainian State University of Chemical Technology, Dnipro

"GREEN" SYNTHESIS OF SNO_2 NANOPARTICLES

Recently one of important research field was nanoscience which contains emerging technologies with interdisciplinary fields like physics, chemistry,

biology, material science, and medicine. There was major need for eliminating harmful reagents and to provide efficient green synthesis of nanoparticles was mostly used. Bio-directed synthesis of nanoparticles shows valuable interest to various research fields such has biologists, chemists, materials scientists and also to find greener methods of inorganic material synthesis. Transition metal nanoparticles were gaining importance due to their phyto-synthesizing property which resulted in biocompatibility, low toxicity, green approach and environmental friendly nature. SnO_2 nanoparticles has a direct optical band gap of 2.5–3.4 eV energy due to it can act has a p-type semiconductor metal. The SnO_2 NPs were applied in the area of solid state gas sensor, solar cells, rechargeable Li batteries and optical electronic devices. The success in many of its technological applications depends on crystalline SnO_2 with a uniform nanosize pore structure [13]. Efforts toward the development of tin oxide nanomaterials with high sensitivity, excellent selectivity, quick response and recovery behavior to gases has increased over years.

There are many methods like energy ball billing method, homogenous precipitation, hydrothermal, sonochemical, solvothermal, microemulsion and sol–gel for synthesizing SnO_2 nanoparticles. But these methods lead to some toxic effects to the environment and human health due to the effect of usage of toxic solvents and chemicals.

Green synthesis of metal oxide nanoparticles is an area of interest having significant focus in present scenario with important objective of facilitating the manufacture of nanotechnology based products eco-friendly and safer for all beings with sustainable commercial viability. However some surfactants are toxic and lead to impurities in the final product and hamper the application of these nanomaterials in electronic and sensing devices. The surfactants have to be removed by burning the samples at higher temperature to improve thermal stability and the purity of the tin oxide for catalysts and electrochemistry.

Antioxidants play an important role in the functioning of all bio systems. In biological systems; free radicals are generated due to interaction of biomolecules with molecular oxygen which results in the degradation of biomolecules. The antioxidant activity of the synthesized sample is explored by monitoring the total antioxidant capacity. The total antioxidant capacity of the extract was assessed with the help of the phosphomolybdenum method, which is based on the recovery of Mo (VI) to Mo (V) by means of the extract and, consequently, the formation of a green phosphate complex/Mo (V) at an acidic pH value.

Our objective in this work is to reduce tin chloride to tin oxide nanoparticles using a biomaterial that addresses two major factors, the need for the biomaterial to be environmentally benign and produce no toxic industrial waste and for it to be cost-effective and easily produced.

To achieve this goal, the authors solved the following tasks: – to obtain an aqueous grape skin extract (GSE) in conditions of a short-term action of low-temperature plasma discharge and to study its componential composition and antioxidant properties;

– to determine the conditions for obtaining nanosized mono- (SnO_2)NPs with the help of plasmochemically obtained aqueous/ ethanol (EtOH) grape skin extracts.

For synthesis of SnO_2 nanoparticles we choose ethanol (EtOH)/water extract which contains high nutritive value in it, because SnO_2 was one of the high sensitivity materials for sensor applications that too mainly towards reducing gases.

$SnCl_4.xH_2O$ was procured from sigma Aldrich. All glass wares were cleaned with aqua regia and rinsed several times with de-ionized water. 30 ml of bidistilled water and 20 ml EtOH were added to 1 g of dry grape skin powder and stirred. The resulting mixture was placed in a plasmochemical reactor. The scheme and the principle of the plant operation are given in [1]. The mixture was treated for 5 minutes (at the amperage of I=120 mA and P=0.8 MPa), cooled and filtered. To the 20 mL of ethanol (EtOH)/water extract, 80 mL of stannous chloride solution was mixed.

A wide range of compounds was found in the plasmochemically obtained aqueous extract of the grape skin extract. The present phenolic acids, namely: gallic acid (9.1 %), hydroxymethylfurfural (4.7 %), 3.4-dihydroxybenzoic acid (4.5 %), 4-hydroxybenzoic acid (3.2 %), 3.4-dioxycinnamylic acid (2.2 %); anthocyanins (34 %) structurally representing glycosides at the 3-position anthocyanidins: malvidin, dolphinidin, petunidin, peonidin and cyanidin. The flavonol group is represented by quercetin and its derivative quercetin-3-O-glucoside. The extract contains catechin, epicatechins and epicatechin gallate. The obtained data testify to the presence of antioxidant properties in the plasmochemically obtained grape skin extract. The total antioxidant activity is 571±1.38 mg of AsA/g of the extract.

The formation of SnO_2 nanoparticles was monitored with the help of UV–visible spectroscopy. The absorbance of the reaction was recorded from 200 to 800 nm. This shows the clear Surface Plasmon Resonance (SPR) with the absorbance at the peak range of 224 nm (Fig. 1). Also the SPR value was compared with the literature [2-3], it clearly confirms the formation of SnO_2 nanoparticles. For semiconducting materials (SnO_2 NPs), the quantum confinement effect is expected, and the absorption edge will be shifted to higher energy when the particle size decreases. The value of absorption edge sample is 224 nm.