CHEMISTRY TODAY-2016

AGRICULTURAL UNIVERSITY OF GEORGIA
ASSOCIATION OF PROFESSIONAL CHEMISTS OF GEORGIA

For better tomorrow

CHEMISTRY TODAY-2016

5-th International Conference of Young Scientists

September 18-21, 2016
Tbilisi, Georgia

5-th International Conference of Young Scientists

განათლებისა და მეცნიერების
საერთაშორისო ფესტივალი • თბილისი 2016
INTERNATIONAL SCIENCE
AND INNOVATION FESTIVAL • TBILISI 2016

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Wellcome!

Dear Colleagues,

The Organizing Committee cordially invites you to the 5-th International Conference of Young Scientists (Chemistry Today-2016) which is organized by the Agricultural University of Georgia and Association of Professional Chemists of Georgia.

The conference series "Chemistry Today" is a scientific event that has been established in Georgia since 2011 attracting attendees from various universities of Europe and Asia.

The first three conferences were held in Georgia. The venue of the 4-th conference was Yerevan, Armenia, confirming that conference "Chemistry Today" really became an international famous conference. ICYS-2014 was held on August 18-22, 2014 and was organized by Young Chemists Association of Armenia and Association of Professional Chemists of Georgia.

The 5-th International Conference of Young Scientists will continue the same tradition of the prior Chemistry Today's, offering a scientific program dealing with the latest developments in new methods in chemistry. The meeting will create an environment for in-depth, informed discussions highlighting the importance of chemistry in the industry and academia. There is also wide space for oral and poster contributions to allow established colleagues as well as young researchers to discuss their latest results and achievements. Besides the scientific aspects of the program, you will have a chance to appreciate the scenes of Georgia and visit historic regions of our country.

It is an honor and challenge for us to organize Chemistry Today-2016 again in Georgia, and we will work hard to ensure a rewarding event, both scientifically and socially.

Chemistry Today -2016 is included in the program of Science and Innovation week - comprising a lot of interesting exhibitions, lectures, presentations, scientific events, etc and organized by Ministry of Education and Science of Georgia.

Organizing committee

Organizers

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O14. PREPARATION OF W-Cu COMPOSITE POWDER FROM SALT PRECURSORS BY SHS

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Tungsten-copper composite materials are engineered materials made from two constituent elements with significantly different physical and chemical properties which remain distinct at the macroscopic and microscopic scale within the final structure. W-Cu composites are made from a refractory phase - tungsten, which possess high strength and low coefficient of thermal expansion, and a Cu-phase having high thermal and electrical conductivity. The combination of these elements optimizes some properties such as ductility, strength, corrosion and wear resistance [1]. In the recent years, W-Cu composites have gained great importance in automotive, electrical, and military industry because of their high thermal conductivity, low thermal expansion, high wear resistance and excellent electrical conductivity. They are used as electrical contacts, resistance welding electrodes, heat sinks, electro-forging dies, packaging materials, and so on. The fabrication of a full density W-Cu composite is very difficult issue. Because of the big difference between melting points of tungsten and copper, there is no overlap of sintering temperature range and no mutual solubility which means poor sinterability. The infiltration of a porous-sintered tungsten skeleton by liquid copper is one of the most common methods for producing W-Cu composite [2]. However, in this method defects like pores, copper lakes, and tungsten agglomerates form easily, so this technique results in a poor quality. Other methods to fabricate W-Cu composites include the following: thermal-mechanical process, metal powder injection molding, hot extrusion, liquid sintering, microwave sintering, etc. Although one of the modern methods in producing composites is energy-efficient combustion synthesis, in which the

particles of obtained material would be partially merged, followed by hot-explosive consolidation of powder.

In this work W-Cu composite preparation was realized particularly from copper tungstates, where W and Cu are chemically bonded and being in the same crystalline structure will promote to the formation of homogeneous microstructure of final product. Copper tungstate was prepared by different ways: (i) calcination of WO_3 and CuO powders with a molar ratio of 1:1 (25.55 wt.% CuO) in air at 700°C for 3 hrs (SSA 1 m^2/g); (ii) chemical coprecipitation using sodium tungstate and copper sulfate (22 m^2/g), (iii) chemical coprecipitation using ammonium tungstate and copper sulfate (25 m^2/g), and (iv) sol-gel method using ammonium paratungstate and copper nitrate (4 m^2/g) as precursors. The obtained copper tungstates were characterized by XRD, SEM, IR and adsorbtion analyses methods. It was shown that more homogeneous $CuWO_4$ salt with smaller particle size is formed due to chemical precipitation methods (with average particle size less than 100 nm).

The reduction of copper tungstates by means of *y*Mg+*x*C reducing mixture was investigated in the combustion mode. Based on thermodynamic analysis results experiments were carried out within thermodynamically selected optimal intervals (y=1.5-1.7 moles, x=1.8-3 moles, T_{ad}=1000-1500°C). It was shown that the change of carbon amount in the $CuWO_4$-1.6Mg-xC system essentially influnces on the combustion parameters (T_c and U_c), as well as on the phase composition of combustion products. At that, the increase in x leads to significant decrease in T_c and U_c. At the same time reduction degree of metals increases with the increasing of carbon content, and when the amount of carbon is in the range of $2 \le x \le 3$ combustion product contains Cu, W, $Cu_{0.4}W_{0.6}$, and MgO. Byproduct magnesia removed from the target compounds by acid leaching process (10% HCl aqueus solution). Microstructure examinations have shown that the combustion products are homogeneous, without molten areas, and particles are in the submicron range. Gas chromatography analysis results points to formation of CO and CO_2 as gaseous products, where CO exceeds about 5 times CO_2 at the change of carbon amount in the range of x=2-2.5 moles.

W-Cu nanocomposites developed by CS process were subjected to densification into cylindrical rods using hot explosive consolidation (HEC) technology to fabricate high dense cylindrical billets. Preliminary explosive

densification of the nanocrystalline W-Cu precursor powder blend is carried out at room temperature with a loading intensity up to 10GPa to increase the initial density and to activate the particle surfaces in the blend. Already predensified cylindrical rods are reloaded by primary explosive shock wave with a loading intensity near to 10GPa, but at a temperature from 800 up to 1050°C.

The investigations showed that explosive consolidation of CS nanopowders allows to consolidate cylindrical bilets near to theoretical density without cracks and cavities. The obtained samples are characterized with good integrity which depends on the distribution and size of the W and Cu particles.

Thus the possibility of complete and combined reduction of copper and tungsten in the $CuWO_4$-Mg-C system and obtaining of W-Cu powder at certain amounts of reducers was demonstrated for the tungstate obtained by different methods, as well as HEC technology considered as an alternative way to fabricate novel Cu–W compacts with tailored properties.

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