

## Nanocomposites and nanomaterials

### Electrolytic nano-scale composite powders of WC and W<sub>2</sub>C produced in molten salts for electrocatalysis

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Nanocrystalline powders of tungsten carbides play an important role in improving processes of chemical technology, where they can be used for PEM fuel cell application, methanol electrooxidation [1, 2] and so on.

Electrochemical synthesis in molten salts has great possibilities to produce doped and undoped tungsten carbides in one step in the form of films and ultra-fine powders. The compositions of electrolyte bathes for tungsten carbides synthesis were determined based on literature analysis and own experimental data [3]. Electrochemical study of partial and joint electroreduction of synthesis components (tungsten and carbon) from chloride-oxide, chloride-fluoride-oxide melts under CO<sub>2</sub> pressure at 750°C was studied by cyclic voltammetry. Electrolysis conditions for producing of nano-scale composites based on tungsten carbides with carbon nanomaterials (CNM) and metals were determined. Characterization of produced deposits was made by XRD, ED, SEM, TEM, BET, Raman spectroscopy methods.

Present investigations have shown that it is possible to produce the mixtures of nanosized powders of composites (WC and W<sub>2</sub>C) with CNM (carbon nanotubes, nanofibers), metals (Co, Fe, Ni, Pt) of different composition, single crystals of δ-WC with the specific surface up to 40 m<sup>2</sup>/g. Produced materials were tested as electrode material in the reaction of hydrogen electroreduction in the solution of H<sub>2</sub>SO<sub>4</sub> and have shown high electrocatalytic characteristics.

1. *Nikolic V. M.* On the tungsten carbide synthesis for PEM fuel cell application – Problems, challenges and advantages // Journal of hydrogen energy.–2014.–**39**.–P. 11175-11185.
2. *Wang Yi.* A facile soft-template synthesis of ordered mesoporous carbon/tungsten carbide composites with high surface area for methanol electrooxidation // Journal of Power Sources.–2012.–**200**.–P. 8-13.
3. *Novoselova I., Nakonechnaya E., etc.* Electrochemical Synthesis of composite materials based on nanosized powders of tungsten carbides in molten salts // Metallofizika i novejšie tekhnologii.- 2014.-**36**.-P. 491-508.