STRUCTURAL PROPERTIES OF BIFUNCTIONAL CATALYSTS FOR ZINC-AIR BATTERIES

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The zinc-air batteries are a type of the group of metal-air systems that use the oxidation of a meal with oxygen from atmospheric air to generate electricity [1]. It is furnished with an anode prepared from an appropriate metal and a gas diffusion electrode (GDE), which is connected to a source of air. The catalysts in the air cathode support the electrochemical reaction with the oxygen gas. Lately, metal-air batteries have attracted considerable research attention as a new generation of high-performance batteries as they feature simple design structure, very high energy density, and a relatively inexpensive production. The use of a zinc anode is particularly attractive due to its low cost, non-toxicity, and potential for high energy density (1.3 kWh kg^{-1} theoretically). Most commonly, the GDE consists of two layers: (i) a porous gas diffusion layer (GDL), which serves to transport oxygen and is composed of both a carbon-based material and a hydrophobic binder, and (ii) a catalytic layer (CL) composed of carbon material, which provides the electrochemical reaction in combination with a metal conductor [2]. It has been identified that the main reason for the limitation in the battery system performance and lifetime is the use of carbon in GDE. The problem of replacing the carbon-containing GDE with a novel design of a carbon-free electrode is currently very relevant. A possible approach is to use some catalysts with electronic conductivity [2-5]. The latest advances in developing non-precious metal catalysts are achieved by utilizing of bifunctional catalysts based on transition metal oxides. We report the performance of test electrodes employing catalyst powder materials both commercially available and nanostructured powders prepared by a specific innovative procedure as well as the structural characterization of such catalysts as Co_3O_4, Ni+ Co_3O_4, (70:30), $NiCO_2O_4$, Ni+ $NiCO_2O_4$ (70:30) by several techniques including X-ray diffraction (XRD) and neutron diffraction (ND).The ND studies were conducted by the time of the flight method (TOF) on the spectrometer DN-12 of JINR, Dubna at the pulsed reactor IBR-2M. The ND data were analysed using the FULLPROF suite by applying profile matching mode followed by full profile Rietveld refinement of the structural model.

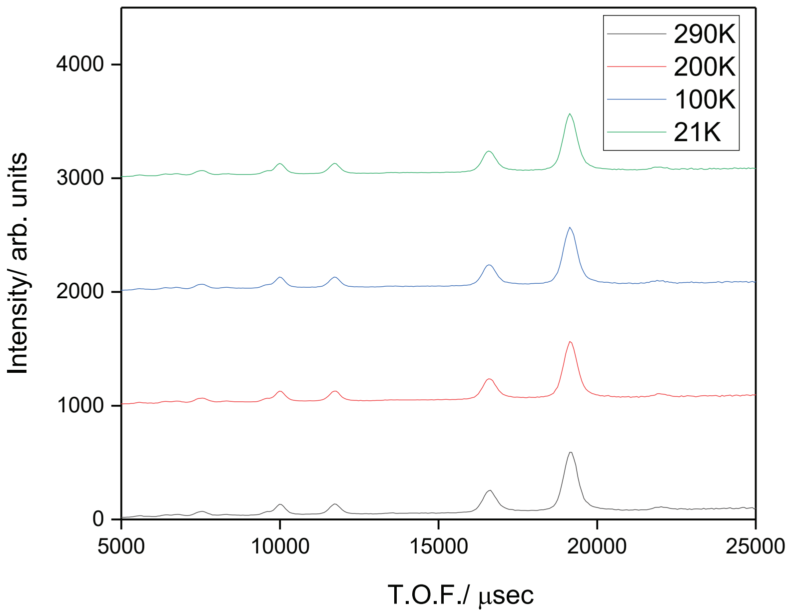

Fig.1 Succesive TOF patterns taken at stabilized temperatures in decreasing order (in K): 290, 200, 100, 21. The patterns are vertically shifted to improve visibility.

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