По содержанию углерода, вольфрама, хрома электрохимическое покрытие Ni-Cr-W-C приближается к составу быстрорежущей стали марки Р6М5. Микроструктура покрытия, осажденного при плотности тока 15 мА/см^2, имеет более однородное распределение ультрадисперсных фаз, чем в сплаве марки Р6М5. В отличие от указанного сплава, полученного металлургическим способом, в сплаве Ni-Cr-W-C, полученном электрохимическим путем, легирующие элементы (хром, вольфрам) присутствуют в «твердом растворе», что делает возможным при последующей термообработке формирование в никелевой матрице двойных карбидов хрома и вольфрама в ультрадисперсной форме. Увеличение микротвердости покрытия при термообработке свидетельствует о протекании процессов фазообразования и делает возможным получение покрытий с физико-механическими характеристиками, аналогичными таковым для высоколегированных сплавов железа.

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ELECTROCATALYTIC PERFORMANCE OF NANOSTRUCTURED AND COMPACT TITANIA FILMS MODIFIED BY GOLD NANOPARTICLES

Search of highly efficient non-platinum electrocatalysts for oxygen electroreduction reaction (ORR) is crucial issue to expand practical application of fuel cells. In general, Au is regarded as a poor catalyst for ORR. However, supported gold nanoparticles (Au NPs) exhibit higher electrocatalytic activity in comparison with bulk gold [1]. The activity of Au NPs is also very sensitive to their morphology, preferential crystal orientation, surface pretreatment, deposition method, etc [2, 3]. The main goal of the present work is to study the effect of Au NPs loading on the efficiency of Au decorated titania nanostructured and compact films for ORR in an alkaline medium.

Before preparation of titania films, Ti sheets (99.6%) were polished mechanically and then chemically. Thermal TiO_2 films ($tTiO_2$) were obtained by annealing of the Ti sheets at 450 °C for 1 h. Nanostructured TiO_2 films ($nTiO_2$) were produced by two-steps anodization of Ti in

ethylene glycol electrolyte containing 0.75 wt.% NH_4F and 2 vol.% H_2O followed by annealing of the samples at 450 °C for oxide crystallization.

Colloidal Au NPs with an average diameter of 5 nm were fabricated via method described in [3]. To study the influence of Au NPs loading on the activity of Au-TiO_2 systems in ORR, different amount of Au NPs (0.75÷6 μg/cm^2) was deposited from sol onto the TiO_2 electrodes. Electrocatalytic activity of Au modified TiO_2 electrodes toward ORR was examined by cyclic voltammetry (CV) using an Autolab potentiostat in a 0.1 M KOH solution saturated with oxygen.

The annealed $nTiO_2$ samples have well-aligned nanotubular structure with a relatively narrow distribution of the inner diameter (60±5 nm) and the wall thickness (12±2 nm) of vertical nanotubes having a length of 10±1 μm. The $tTiO_2$ films obtained via thermal oxidation of Ti have compact polycrystalline structure and a thickness of 50 nm. After deposition on the $nTiO_2$ electrodes, Au NPs were found both inside nanotubes and on the surface of the titania layers.

Oxygen electroreduction at the bare titania electrodes demonstrates an irreversible cathodic wave at $E < -0.7$ V for $tTiO_2$ and at $E < -0.6$ V for $nTiO_2$. (Fig. 1). Deposition of Au NPs onto these electrodes leads to the shift of position of the cathodic wave to positive direction. Characteristically this shift depends on the surface concentration of deposited Au nanoparticles. In case of the Au modified $tTiO_2$ electrodes, an increase of the amount of Au NPs from 0.75 to 3 μg/cm^2 reduced the overvoltage of ORR by 0.1 V at a current density of 100 μA/cm^2 (Fig. 1a). Somewhat different behavior was observed for $nTiO_2$ electrodes. Decreasing the ORR overvoltage with an increase of the deposited Au NPs from 0.75 to 3 μg/cm^2 was significantly larger, and even an additional Au-catalyzed wave was developed starting from 3 μg/cm^2 (Fig. 1b). Further increase of the amount of deposited Au NPs up to 6 μg/cm^2 did not lead to any changes of the behavior of Au-modified $nTiO_2$ electrodes. The observed behavior of the Au-modified titania electrodes can be rationalized by peculiarities of the electron transport through Schottky barrier formed at the Au NPs – TiO_2 interface.

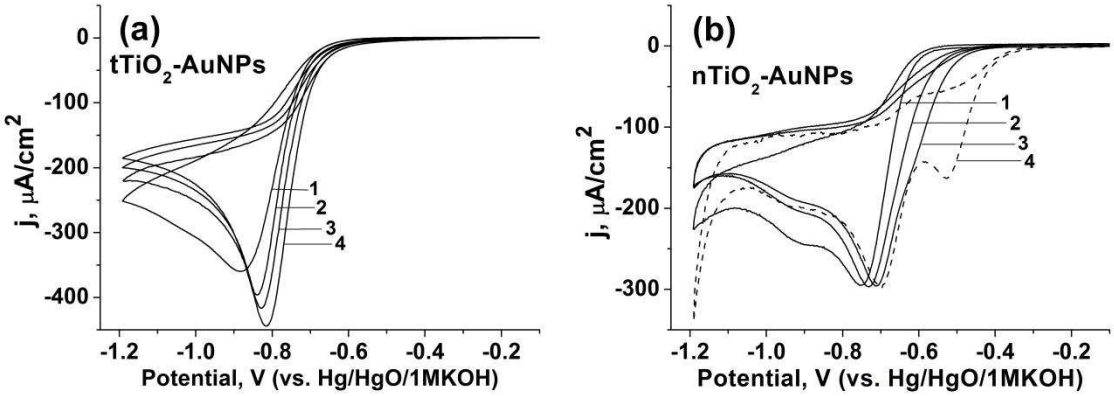

Figure 1 − CVA curves of ORR on $tTiO_2$ (a) and $nTiO_2$ (b) before and after modification by 5 nm-Au NPs (1 – bare TiO_2; 2 – TiO_2-0.75 μg/cm^{2}Au; 3 – TiO_2-1.5 μg/cm^{2}Au; 4 – TiO_2 - 3 μg/cm^{2}Au)

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ИЗМЕНЕНИЕ МАГНИТНЫХ ПАРАМЕТРОВ НАНОТРУБОК ПЕРМАЛЛОЯ В ЗАВИСИМОСТИ ОТ ИХ ДЛИНЫ

Существует ряд методов синтеза металлических нанотрубок (НТ), включая электрохимическое осаждение [1], электронно-лучевую литографию [2], химическое осаждение из паровой фазы [3], импульсное лазерное осаждение [4] и некоторые другие методы [5–7]. Метод электрохимического осаждения подходит для синтеза металлических наноструктур, поскольку он позволяет манипулировать физическими и химическими свойствами