DEVELOPMENT OF ZINC-NICKEL 3D STRUCTURE ON TITANIUM PLATE FOR HYDROGEN PEROXIDE REDUCTION REACTION

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INTRODUCTION

Zinc-nickel 3D coatings were made on a titanium plate (ZnNi/Ti) by electrochemical deposition from a solution that contained 0.4 M $Zn(NO_3)_2$ and 2 M $NiSO_4$. Electroplating was performed under different time and current density conditions: 1) 500 $mAcm^{-2}$ for 1 min; 2) 50 $mAcm^{-2}$ for 1 min and 500 $mAcm^{-2}$ for 5 min; 3) 50 $mAcm^{-2}$ for 1.5 min, 250 $mAcm^{-2}$ for 1.5 min and 500 $mAcm^{-2}$ for 2 min. Coating surface and combination of chemical elements were inspected using scanning electron microscopy, energy-dispersive X-ray spectroscopy, X-ray diffraction, and inductively coupled plasma optical emission spectroscopy. To compare and evaluate the electrocatalytic activity of the coated electrodes for the hydrogen peroxide reduction reaction, a cyclic voltammetry method was used. For the final measurements, cyclic voltamperograms were recorded in a 0.1 M KOH and 0.05 M H_2O_2 solution at a potential scan rate of 10 mV s^{-1} in a potential range from -0.8 to 0.2 V vs. Ag/AgCl at a temperature of 25 °C since it showed the best results.

Table I. The preparation of the 3D Zn-Ni coatings from a bath containing 0.4 M $Zn(NO_3)_2$, and 2 M $NiSO_4$.

Coatings	Deposition conditions		Elements, at%	
	j / $mAcm^{-2}$	t / min	Zn	Ni
ZnNi/Ti-1	500	1	45	55
ZnNi/Ti-2	50	1	55	45
	500	5		
ZnNi/Ti-3	50	1.5	45	55
	250	1.5		
	500	2		

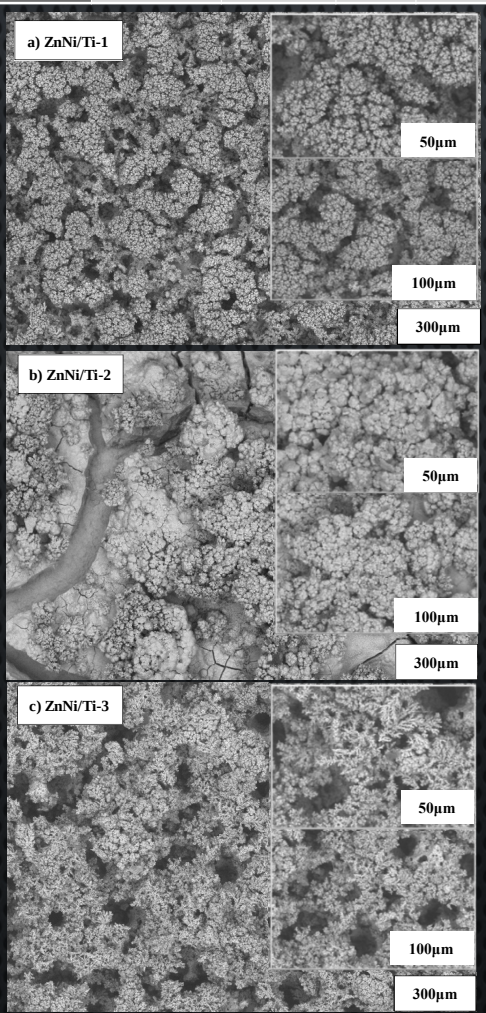

Fig. 1. SEM views: (a) ZnNi/Ti-1, (b) ZnNi/Ti-2 and (c) ZnNi/Ti-3.

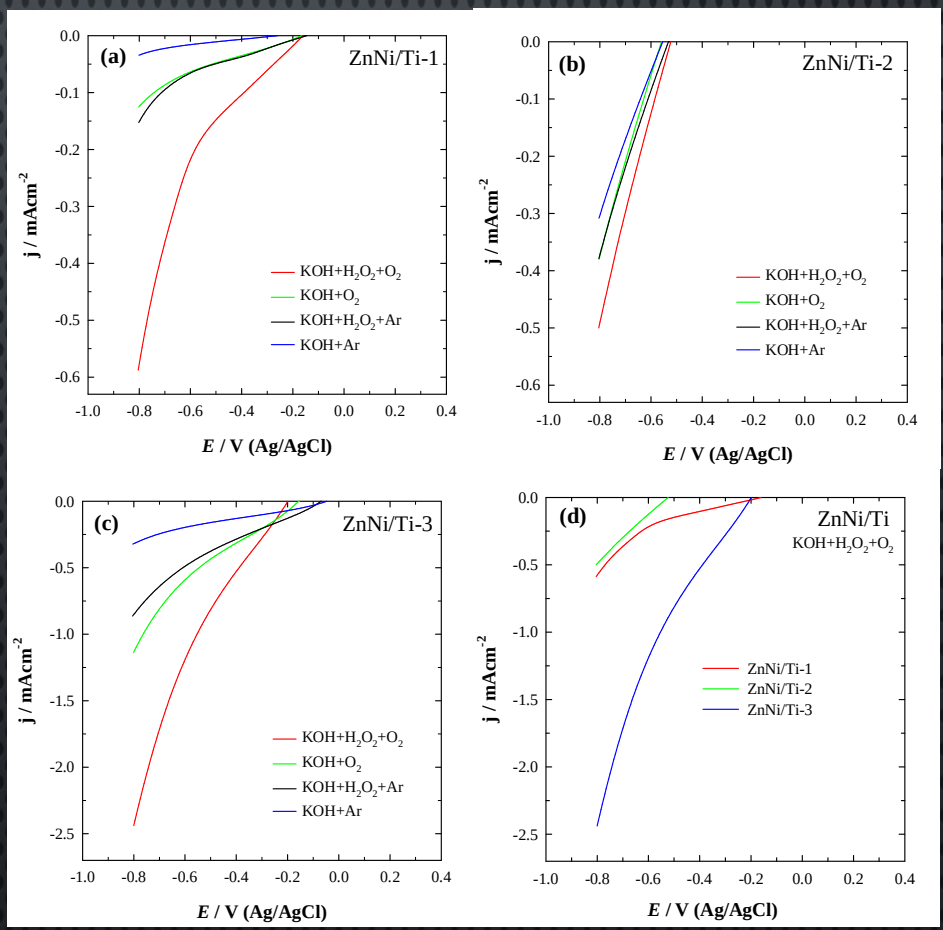

Fig. 2. Cathodic scan voltammograms of ZnNi/Ti coatings: (a) ZnNi/Ti-1, (b) ZnNi/Ti-2, (c) ZnNi/Ti-3 in a 0.1 M KOH sulution saturated with Ar (*blue line*); in 0.1 M KOH containing 0.05 M H_2O_2 saturated with Ar (*black line*); in 0.1 M KOH sulution saturated with O_2 (*green line*) and in 0.1 M KOH containing 0.05 M H_2O_2 saturated with O_2 (*red line*). (d) Comparison of different ZnNi/Ti coatings in 0.1 M KOH containing 0.05 M H_2O_2 saturated with O_2. Potential scan rate 10 mVs^{-1} at 25C.

CONCLUSIONS

3D metal Zinc-Nickel structures were prepared by electrochemical deposition on titanium surface.

The highest electroactivity for hydrogen peroxide reduction reaction was achieved using ZnNi/Ti-3 electrode, made under conditions of 50 $mAcm^{-2}$ for 1.5 min, 250 $mAcm^{-2}$ for 1.5 min and 500 $mAcm^{-2}$ for 2 min., consisting of 45 at. % of Zn and 55 at. % of Ni.

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