GALVANIC DEPOSITION OF METALS WITH ELECTROCATALYTIC PROPERTIES

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ABSTRACT

This work deals with the preparation of galvanic deposited metals under formation of alloys. Then the formation was followed by their activation these alloys, first of all alloys Ni-Zn which led to the removal of Zn in alkaline hydroxide. Last part deals with the estimation of their electrocatalytic properties.

1. INTRODUCTION

The basic idea was the preparation of catalytically active layers by chemical leaching of Zn from alloys Ni – Zn. The results will be used for the improvement of electrolytic cell for the production of hydrogen.

2. EXPERIMENTAL

Galvanic deposition was done in plating bath SLOTOLOY ZN 80 (produced by Dr.-Ing. Max Schlötter GmbH & Co.KG, SRN). Plating baths were created with different content of nickel 5, 8, 9 g/l. Some samples were not possible to use in next research, because these samples had very thin coat or they were not coated on all surface. Remaining samples were prepared for next research. Each of these samples was divided into two parts. First part was immersed into alkaline hydroxide for dissolution of zinc component.

g/l Ni	**5,00**	**8,00**	**9,00**
□m	**2,73**	**0,75**	**0,61**
% Ni	**27,61**	**52,55**	**58,09**

Table 1: concentrations of the Ni in deposition

These samples were prepared for measuring on device AUTOLAB (Eco Chemie) and evaluated with program GPES. The supporting electrolyte was 1M KOH in distilled water. Measuring apparatus has three parts reference, counter and work electrode. The samples were connected as work electrode. Saturated Calomel Electrode was connected as reference

electrode. Platinum electrode was connected as counter electrode. Connection diagram is in Fig. 1. Samples before corrosion of zinc component and after it were tested in described way by means of cyclic voltammetry.

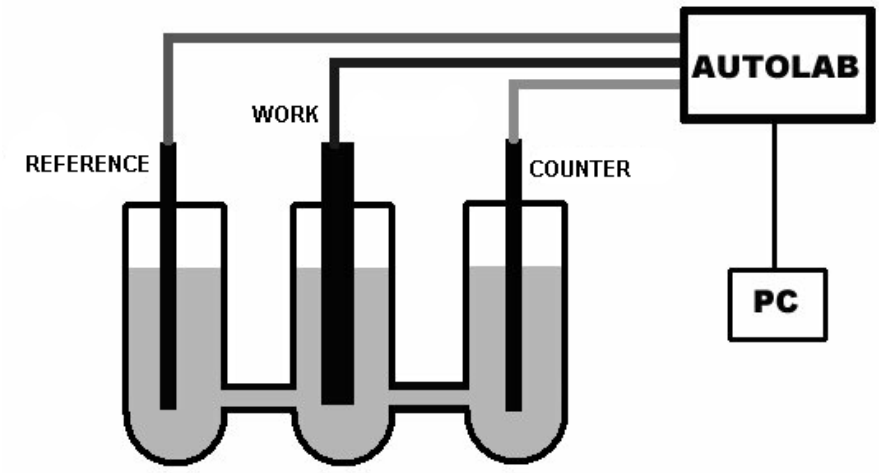

Fig. 1: Connection diagram

3. RESULTS AND DISCUSSION

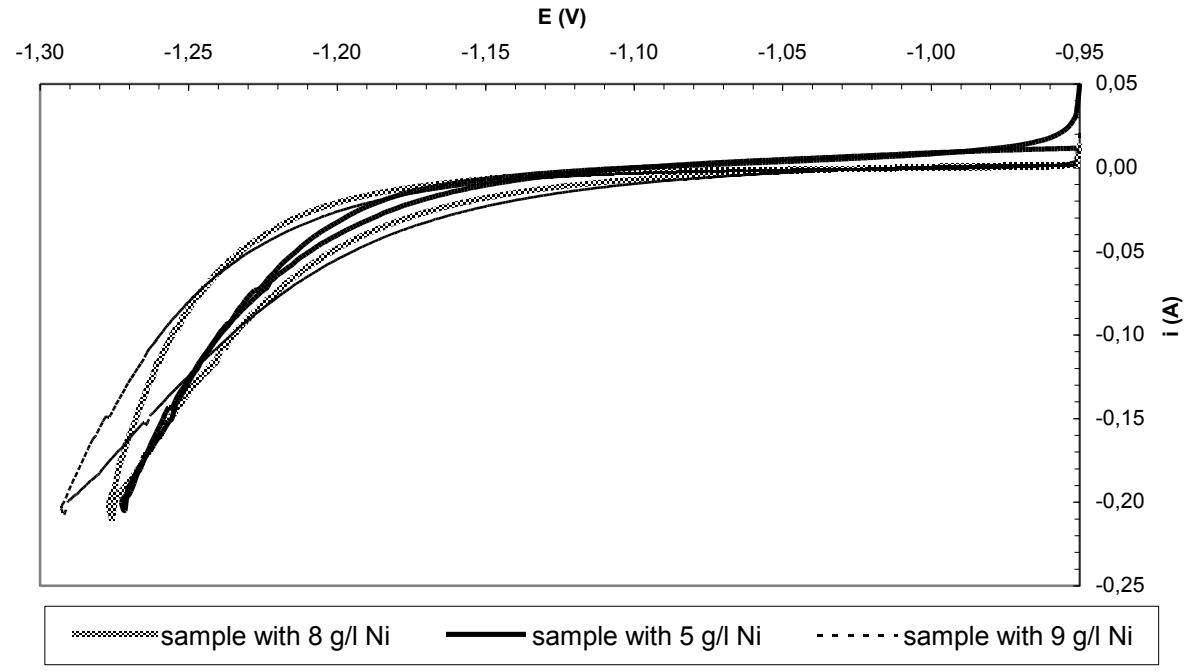

Fig. 2: Voltage-current curves of samples before dissolution of zinc component

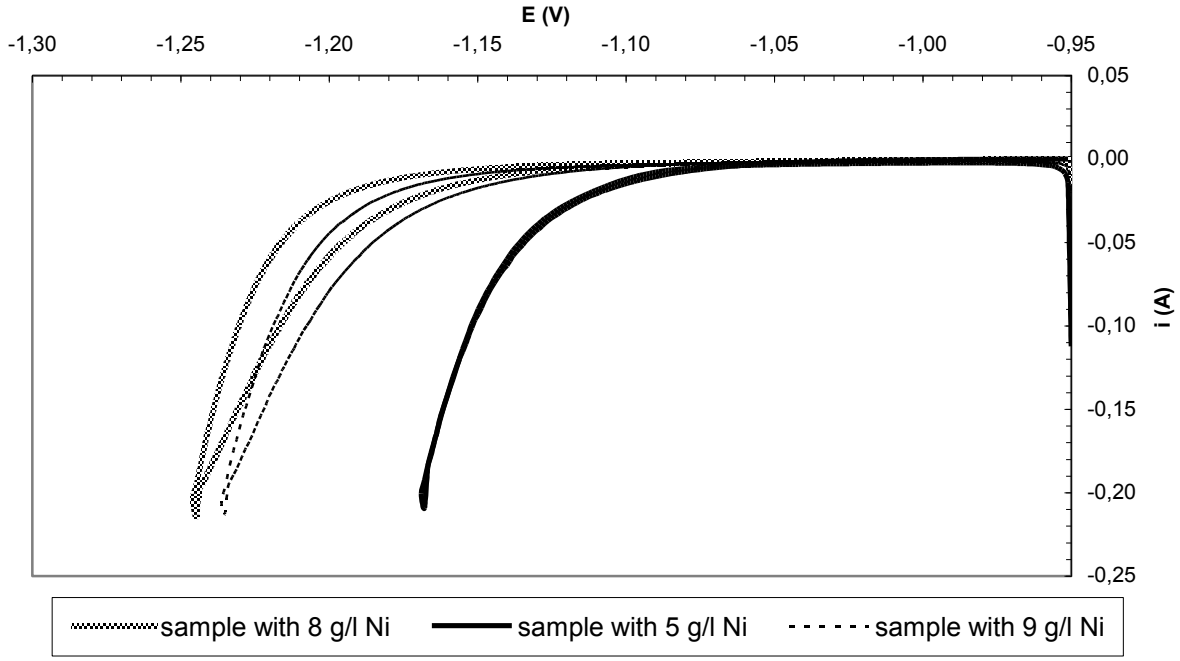

Fig. 3: Voltage-current curves of samples after dissolution of zinc component

How we can see in graphs of all samples before and after dissolution of zinc component, the sample with 5 g/l Ni is the most acceptable. In this case difference potential before dissolution of zinc component and after it is 0,1 V, while other samples improved about 0,04 – 0,06 V. This difference can be caused by thickness of samples. The sample with 5 g/l Ni had thickness 2,73 □m, but the sample with 8 g/l Ni had thickness only 0,75 □m and the sample with 9 g/l Ni only 0,61 □m. It is confirmed in graph of all samples before dissolution of zinc component, where curves are very similar. The behavior of samples with 8 g/l Ni and with 9 g/l Ni with similar thickness is similar, but curve of the sample with 5 g/l Ni is very different from curves of the sample with 8 g/l Ni and with 9 g/l Ni.

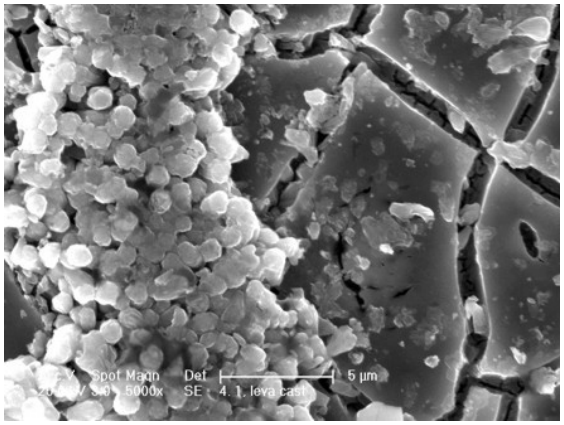

Fig. 3: sample with 9 g/l Ni before dissolution of zinc component

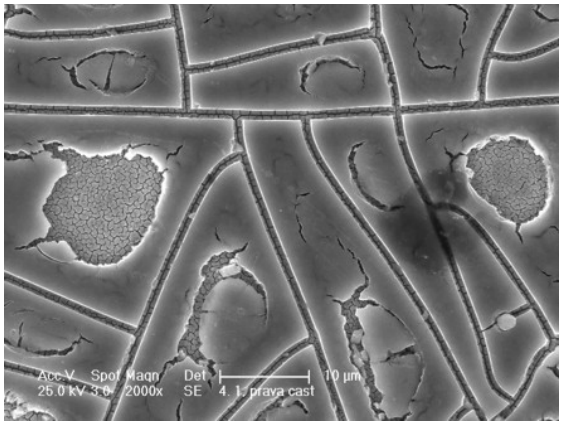

Fig. 4: sample with 9 g/l Ni after dissolution of zinc component

Last part of experimental work was done at Scanning Electron Microscope (SEM). We can see the sample with 9 g/l Ni before dissolution in Fig. 3 and after it in Fig. 4. Small white particles at Fig. 3 are zinc components. If zinc components are removed, we can see basic material with very thin coat of nickel. We can see in Fig. 4, that some places are corroded out definitely to basic material. That's why useful surface is descending and impedance of electrode is increasing.

4. CONCLUSION

Purpose of this work was to create galvanic deposits of metals with electrocatalytic properties. This galvanic deposition will be used to create the best electrodes for electrolysis cell for hydrogen production. It is clear, that we can create suitable surface for electrodes. Hence, the reduction of energy by their use is possible.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1] KNOTEK, T.: Diplomová práce, Ústav elektrotechnologie VUT, Brno 2007

[2] G. Vatankhah, J. Lessard, G. Jerkiewitz: Electrochimica Acta 48 (2003) 1613-1622

[3] Barek J., Opekar F., Štulík K. Elektroanalytická chemie KAROLINUM

[4] Regner A. Elektrochemické pochody v anorganickém průmyslu SNTL