Interaction of cathodically evolved hydrogen with electroless Ni-P electrode

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Transition metal phosphides have received considerable attention as electrocatalysts [1]. Among them, nickel phosphides have been widely explored for electrocatalytic HER [2,3]. The improved electrocatalytic properties of Ni–P alloy coatings are explained by the influence of different factors. One of them is the ability of amorphous Ni-P electrode to adsorb and absorb significant amounts of hydrogen, which changes the electron structure of the basic metal [4].

Our previous works are devoted on the electrocatalytic properties of electroless Ni-P coatings on a steel substrate in terms of hydrogen reaction in alkaline or acidic media in a wide range of phosphorus content of the coatings [5,6]. The present research is focused on evaluation of the interaction of cathodically released hydrogen with the electroless Ni-P alloy coating. It is well known that the phosphorus compounds play the role of promoters for the penetration of hydrogen during the cathodic polarization of steel, nickel, *etc*. [7]. The electroless deposition of Ni-P itself is accompanied by the evolution of hydrogen, part of which is incorporated into the coating. By electrochemical methods, Devanathan-Stachurski permeation cell, differential thermal analysis, X-ray diffraction and X-ray microanalysis, data are obtained on the process of interaction of hydrogen with Ni-P coating when used as an electrode for HER in alkaline or acidic media - diffusion of hydrogen in the alloy coating, phase transformation, composition and morphology of the alloy coating before and after electrochemical treatment.

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References

1. Y. Li, Z. Dong, L Jiao, *Adv. Energy Mater.* (2019) 1902104 https://doi.org/10.1002/aenm.201902104
2. C. Hu, C. Lv, S. Liu, Y. Shi, J. Song, Z. Zhang, J. Cai, A. Watanabe, *Catalysts* **10** (2020) 188, https://doi.org/10.3390/catal10020188
3. Z. Angeles-Olvera, A. Crespo-Yapur, O. Rodríguez, J. L. Cholula-Díaz, L. María Martínez, M. Videa, *Energies* **15** (2022) 1609 https://doi.org/10.3390/en15051609
4. I. Paseka, *Electrochim. Acta* **40** (1995) 1633-1640 https://doi.org/10.1016/0013-4686(95)00077-R
5. V. Chakarova, M. Monev, *Bulg. Chem. Commun.* **51** (2019) 54-59
6. V. Chakarova, M. Monev, *Electrocatalysis* **14** (2023) 259–266 https://doi.org/10.1007/s12678-022-00791-x
7. J.F. Newman, L.L. Shreir, *Corrosion Science* **9** (1969) 631-641 https://doi.org/10.1016/S0010-938X(69)80117-4