

Electrodeposition of Ni-P: Evolution of Morphology, Microstructure and Composition of Deposits

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The use of Ni-P deposits is widespread due to the unique physical, chemical and mechanical properties which these deposits add to the base substrate. The properties of the alloy are manifold and highly dependent upon the phosphorous content and the plating conditions, making fine-tuning for various applications possible. The properties of these alloy coatings, deposited via electroless and electroplating processes, have recently been compared [1, 2]. The absence of additives such as complexing agents and stabilizers in electroplating solutions as well as the better process control make the electrodeposition of Ni-P more attractive for applications in microsystem technology. The technical aspects of electrodeposition of Ni-P have been extensively studied by various authors in the past. Little attention has been paid, however, up to now on the fundamental aspects of the deposition process. In this contribution we present new results on the evolution of morphology, microstructure and composition during the electrodeposition of Ni-P on various substrates (brass, n-Si, n-TiO₂).

The experiments were carried out in a Brenner-type bath [3] using potentiostatic as well as galvanostatic techniques for deposition of Ni-P. Different techniques were used to improve adhesion of the deposited layers on the n-Si substrates.

Pre-microstructuring of n-Si and n-TiO₂ substrates was carried out by low-energy ion implantation through commercially available masks (i.e. honeycomb).

A typical current transient for electrodeposition of Ni-P on a polished brass substrate is shown in Fig 1. The vertical dashed lines indicate the times where the deposition was stopped and AFM images were acquired. The corresponding morphology evolution is shown in Fig. 2.

XPS measurements have been made to check the composition and the chemical states of the electrodeposits. Depending on the plating conditions, the mechanism of deposition, the morphology and the composition is changing. Different reduction reactions are possible depending on the phosphorus species in the solution. That influences the P – content and the type of P – species incorporated into the layer. To proof the variation of P – content and to check the P – species on the surface XPS measurements were done at the different states.

References:

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2. Peeters, P., v.d. Hoorn, G., Daenen, T., Kurowski, A., Staikov, G., *Electrochimica Acta*, in press
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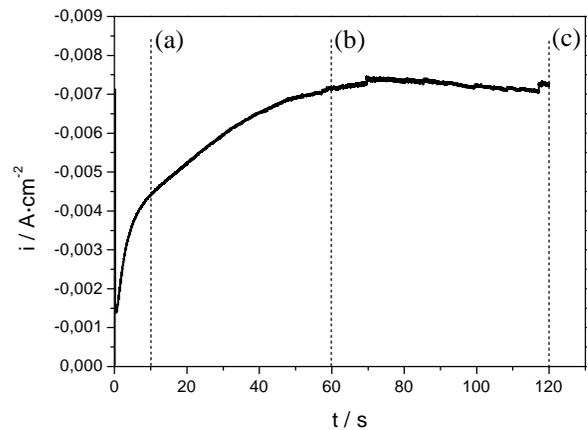


Fig 1: Typical current transient of Ni-P deposition on brass substrate (T = 55°C, U = -400 mV (SHE))

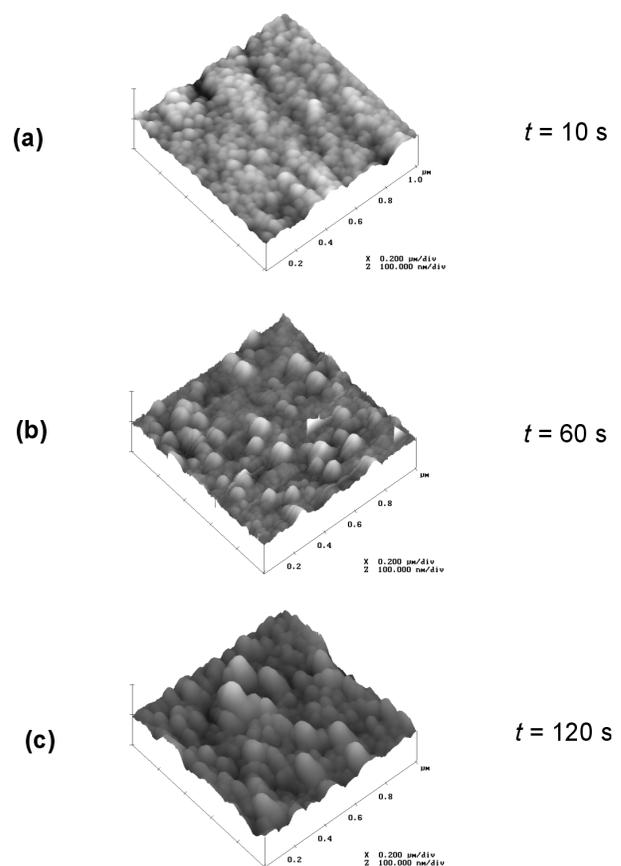


Fig 2: AFM – images of morphology evolution during Ni-P deposition onto brass substrate (deposition conditions as in Fig. 1)