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Estimation of Mechanical Properties of coatings Ni-B using Nanoindentation

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Abstract – In this work is reported the mechanical properties that were measured using nanoindentation of the Ni-B film, obtained in the condition as deposit and with an adequate heat treatment. The hardness of the coatings were calculated using the work-of-indentation model proposed by Korsunsky, and the elastic modulus of the coating was estimated using the King model. The Ni-B film were applied with electroless plating; the process requires the same surface preparation that normally is carried out for the carbon steels applied with the nickel electrolytic deposits, and subsequently the Ni-B electroless plating. The Ni-B bath consists of four reagents: the N^{+2} sources, the reducing agent, complexing agent and stabilizer agent, which do not contain heavy metals. The bath conditions are the following: temperature 60-70 ° C, pH 5-6 and constant agitation.

Wear resistance of materials is a very important aspect from the economic point of view, since lack of wear resistance is one of the important ways for materials to lose utility. To improve wear resistance of materials that are in relative movement, several methods can be applied. One method that is gaining importance is the application of electroless films, being the Ni-B electroless plating a relatively new method to obtain high wear resistance films on metals [1]. Electroless process is presented to apply a Ni-B film on A2 steel (Figure 1); the process requires the same surface preparation that normally is carried out for the carbon steels applied with the nickel electrolytic deposits, and subsequently the Ni-B electroless plating. This process have advantages with regard to existing Ni-B electroless processes at present, have a minimum of components, does not utilize stabilizers based heavy metals salts for example $PbCl_2$ or Tl_2SO_4, which can cause health and environmental problems. The mechanical properties were measured using a nanoindentation system (Hysistron Ub1) of the coating Ni-B, the hardness of the film was estimated by the model proposed by Korsunsky and the elastic modulus was calculated by the model of King as shown Figure (b) and (c) respectively [2,3].

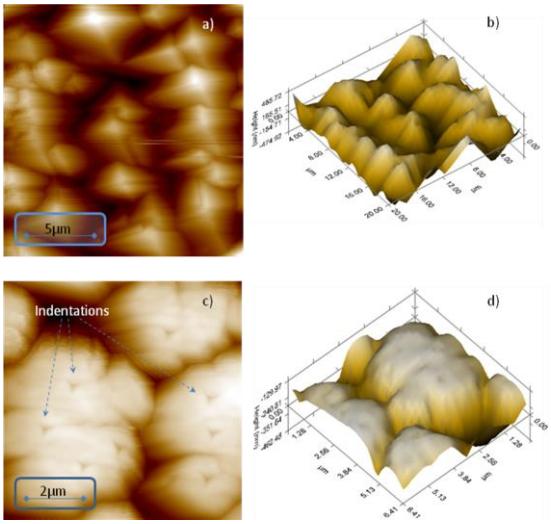

Figure 1: AFM image of Ni-B film, **a)** as deposited **b)** Profile of Ni-B film before of the polishing, **c)** AFM image of Ni-B film after polishing d) Profile of Ni-B film after of the polishing

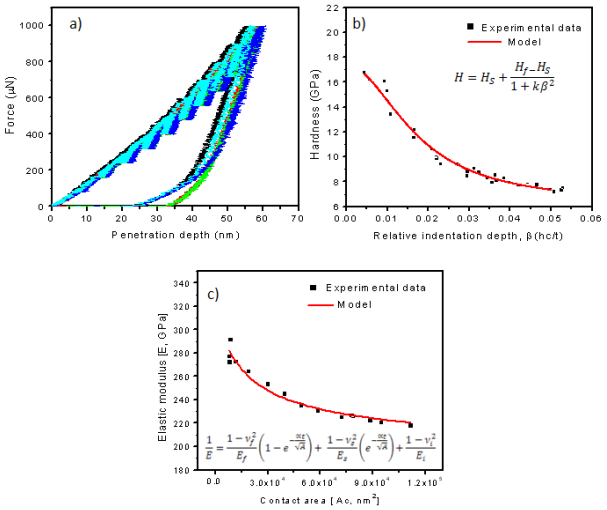

Figure 2: a) Typical multiple nanoindentation load–penetration curves. **b)** Hardness versus relative indentation depth (β) for the sample Ni-B with not heat treatment, continuous line corresponds to Korsunsky model and **c)** Elastic modulus versus contact area. Continuous line is the fitting of the King model

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