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Mechanical and fatigue properties of electro-less Ni-P coating on brass substrates by plasma-etched pretreatment

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Abstract

The pretreatment of brass substrates traditionally involves roughening and then activation, before electro-less coating with a Ni–P alloy. The Taguchi method is used to determine the effect of the parameters for electro-less Ni–P coating on the microstructure, mechanical properties and fatigue life. An orthogonal array (L_9 3^3) and a signal-to-noise ratio and analysis of variance are used to determine the effect of the deposition parameters. In the confirmation runs, using optimal Ni–P thin film deposition parameters (pH 4, plating temperature 70^{o}C, plating time 60 min), the improvement in the fatigue life is 8.10% and in the hardness is 3.61%. Energy dispersive spectrometer (EDS) measurements show that the concentration of phosphorus (P) gradually decreases from 17.07 to 16.83 at.%, which gives the Ni–P films greater hardness and fatigue life. This study replaces traditional roughening and activation pretreatments with oxygen plasma etching. Traditional roughening and then activation produces more micro cracks or micro pores in the coating than the oxygen plasma-etched coating. The intensity of the Ni (200) and (111) diffraction peak, increases for oxygen plasma pretreatments. A comparison of the substrate pretreatment using oxygen plasma etching with traditional roughening then activation shows that the fatigue life is increased from 40 times to 60 times and the film's hardness is increased from 549.3 Hv to 617.3 Hv.

Keywords: Ni-P films, Taguchi method, fatigue life, plasma etching.

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