IMPACT RESISTANCE OF ELECTROLESS Ni-P COATINGS ON ANODIZED AA6061 ALLOY

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Automobile industries required Al components with good mechanical properties. NiP coatings produced by the electroless deposition increase mechanical resistance. Their durability is determined by the adhesion between NiP coating and substrate e.g. anodic Al_2O_3. Activation of Al_2O_3 layer with $PdCl_2$ before NiP deposition increased surface hardness and resistance against the scratching [1] while NiF_2 improved adhesion between Al_2O_3 and NiP coating [2]. Our purpose of this work is to investigate the treatment influence of Al alloy on NiP adhesion.

AA6061 alloy specimens were cleaned in alkaline solution UniClean 151 for 7 min at 55 °C, rinsed in DI water then cleaned in acid solution Alklean AC-2 for 30 s at 30 °C and rinsed again. Anodization was performed in 195 g/l H_2SO_4 with 9 g/l Al^{3+} by applying 15 V DC at 19 °C to obtain a nanoporous Al_2O_3 layer of 5 μm thickness. NiP coating was deposited with or without double zincate activation. After the first zincate treatment in solution Alumseal NCY X2 for 20 s at 20 °C, 40 wt.% HNO_3 pickling for 30 s at 20 °C, second zincate treatment and rinsing, NiP coatings were produced by electroless deposition in solution MARQUEE BMP of pH 4.7 for 40 min at 88–92 °C. Another method includes the formation of NiP coating on the Al_2O_3 without zincate activation. The specimens were rinsed and dried in air.

Qualitative evaluation of NiP adhesion on Al_2O_3 layer was carried out by impact test (ASTM D 2794). A method (U-1, Russia) with an 8 mm diameter spherical ball was used for evaluating the resistance of NiP coating to deformation caused by a falling weight. The opposite side of the impact site of NiP coating was analyzed by optical microscope at 18× magnification.

Cross-sectional studies evaluated by SEM, EDX showed that the thickness of NiP coatings reaches 10 μm with the content of P about 7.0 wt.% in both cases. The adhesion strength of NiP coating was much higher without zincate activation when compared with activation. In the case of Al_2O_3-Zn-NiP coatings, surfaces showed a lot of microcracks (Fig. 1a). Meanwhile, on Al_2O_3-NiP only visible tensions of NiP coating were visible (Fig. 1b).

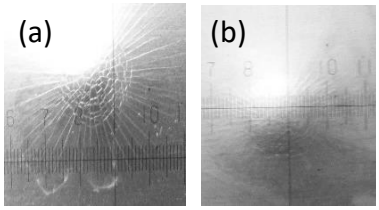

Fig. 1. Optical images after impact tests on the opposite side of anodized specimens: (a) Al_2O_3-Zn-NiP, (b) Al_2O_3-NiP at 18× magnification

Combining of Al_2O_3 layer and electroless NiP coatings led to superior impact resistance when compared to Al_2O_3 with double zincate activation.

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References

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