Influences of Duty Cycle and Pulse Frequency on Properties of Ni-SiC Nanocomposites fabricated by Pulse Electrodeposition

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Ni-SiC nanocomposites (NCs) were fabricated using pulse current electrodeposition (PCED) in this article. Influences of PCED frequency and duty cycle on morphology, structure, wear and corrosion behavior of the resulting NCs were thoroughly analyzed using a variety of instrumental techniques such scanning electron and transmission electron microscopies (SEM and TEM, respectively), X-ray diffraction (XRD) as well as wear, corrosion and nanoindentation tests. The results illustrated that the surface of the Ni-SiC NC obtained at the 20% duty cycle contained small Ni grains with smooth, uniform, and fine microstructure. When the coatings were prepared in the 25-50 Hz pulse frequency range, SiC NPs were homogeneously dispersed in the coating, and the resulting NCs were uniform, compact and contained fine grains. Among NCs fabricated at different pulse frequencies and 20% duty cycle, Ni-SiC coatings deposited at 50 Hz showed the highest microhardness value (equal to 911.9 Hv). Wear weight loss of the Ni-SiC NC prepared at 20% duty cycle was only 18.1 mg, which indicates an excellent wear resistance. In addition, EIS of our Ni-SiC NCs deposited at 50 Hz pulse frequency and 20% duty cycle showed the highest impedance, which implies the best corrosion resistance. The result can be applied to the micro precision transmission mechanism for manufacturing various small electric valves and actuators in engine compartments.

Keywords: Ni-SiC NCs; duty cycle; pulse frequency; structure; wear resistance; corrosion resistance

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