World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:11, No:07, 2017

Nickel Electroplating in Post Supercritical CO2 Mixed Watts Bath under Different Agitations

Authors : Chun-Ying Lee, Kun-Hsien Lee, Bor-Wei Wang

Abstract : The process of post-supercritical CO₂ electroplating uses the electrolyte solution after being mixed with supercritical CO₂ and released to atmospheric pressure. It utilizes the microbubbles that form when oversaturated CO₂ in the electrolyte returns to gaseous state, which gives the similar effect of pulsed electroplating. Under atmospheric pressure, the CO₂ bubbles gradually diffuse. Therefore, the introduction of ultrasound and/or other agitation can potentially excite the CO₂ microbubbles to achieve an electroplated surface of even higher quality. In this study, during the electroplating process, three different modes of agitation: magnetic stirrer agitation, ultrasonic agitation and a combined mode (magnetic + ultrasonic) were applied, respectively, in order to obtain an optimal surface morphology and mechanical properties for the electroplated Ni coating. It is found that the combined agitation mode at a current density of 40 A/dm² achieved the smallest grain size, lower surface roughness, and produced an electroplated Ni layer that achieved hardness of 320 HV, much higher when compared with conventional method, which were usually in the range of 160 to 300 HV. However, at the same time, the electroplating with combined agitation developed a higher internal stress of 320 MPa due to the lower current efficiency of the process and finer grain in the coating. Moreover, a new control methodology for tailoring the coating’s mechanical property through its thickness was demonstrated by the timely introduction of ultrasonic agitation during the electroplating process with post supercritical CO₂ mixed electrolyte.

Keywords : nickel electroplating, micro-bubbles, supercritical carbon dioxide, ultrasonic agitation
Conference Title : ICMAME 2017 : International Conference on Mechanical, Aeronautical and Manufacturing Engineering
Conference Location : Barcelona, Spain
Conference Dates : July 27-28, 2017