Corrosion of Newly Manufactured Nanocrystalline Al and Two of its Alloys in stagnant 4.0% NaCl Solutions

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In this study, pure nanocrystalline Al and two of its alloys; namely Al-7%Cu and Al-7%Cu-3%Ti, were manufactured after 5.0 h milling period of time using mechanical attrition. All samples were sintered for 3 min at 600 °C using high frequency heat induction sintering furnace. The sizes of the crystallite and the hardness of the manufactured Al and its alloys were determined using X-ray diffractometer and Vickers hardness (VH) investigations, respectively. The effect of adding 7%Cu and 7%Cu+3%Ti on the corrosion of the fabricated pure aluminum in 4.0% NaCl solutions was carried out. The corrosion tests used in this study were cyclic polarization, change of current with time, and electrochemical impedance spectroscopy measurements. It was found that the presence of Cu increases the hardness of Al and this effect was highly increased in the presence of Cu and Ti together with Al. Moreover, adding Cu and further Cu and Ti increased the corrosion of Al. Adding Cu and Cu with Ti was found to increase the corrosion current, corrosion rate, anodic current, and cathodic current of Al. All results were consistent with each other and proved that the presence of Cu and Ti increases the hardness as well as the corrosion behavior of Al.

Keywords: nanocrystalline; Al alloys; corrosion; mechanical attrition; Vickers hardness; EIS; polarization

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