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Fabrication of Novel Corrosion-Resistant Aluminum Covered with Porous Oxide Film in a NaCl Solution

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Summary

The formation behavior of the anodic oxide film that forms on aluminum was investigated by galvanostatic anodizing in etidronic acid, and its corrosion resistance was examined in a 3.5 wt% NaCl solution by performing potentiodynamic polarization measurements. The aluminum specimen was galvanostatically anodized in a 0.2 M etidronic acid solution at 293 K, and an amorphous porous oxide film formed on the aluminum surface at lower current densities without oxide burning. The anodizing voltage increased with the current density, whereas excess current density enabled the formation of a nonuniform oxide film due to burning. The nanopores formed in the porous oxide film could be sealed with hydroxides by immersion in boiling water. Corrosion-resistant aluminum with a measured corrosion current density of $i_{corr} = 10^{-7}$ Am^{-2} could be formed by anodizing in etidronic acid. Moreover, highly corrosion-resistant aluminum measuring 10^{-9} Am^{-2} in the corrosion current density was successfully obtained by subsequent pore-sealing. Based on these experimental results, the coating of the porous oxide film formed by anodizing in etidronic acid is a useful technique for corrosion protection of aluminum in a NaCl solution.