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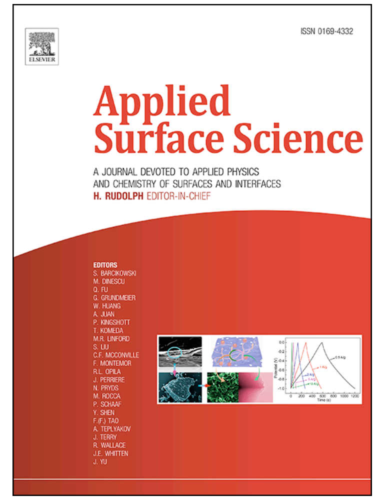

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Corrosion behavior of a β CuAlBe shape memory alloy containing stress induced martensite

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Abstract

The corrosion behavior of a β CuAlBe shape memory alloy containing stress-induced martensite was analyzed after 60 days of immersion in a 3.5 % NaCl solution. The stress-induced martensite was retained in the sample after a load-unload compression cycle up to a pseudoelastic deformation of 4.5 %. The corrosion of the alloy occurs by dealuminization, where β phase located in the areas between the needles of martensite is dissolved due to the preferential loss of aluminum, and the posterior redeposition of copper takes place.

Keywords: Dealloying; retained martensite; Cu-based alloys; microstructure; shape memory alloys.

1. Introduction

The Cu-11.4Al (wt.%) system with small additions of beryllium exhibits shape memory properties due to the martensitic transformation (MT). At high temperatures, β phase is stable with a disordered structure, however, it can be retained at low temperatures by rapid cooling [1-2]. The disordered β phase orders to a DO_3 structure during cooling [3]. Under slow cooling from high temperature, the metastable β phase decomposes into the phases γ_2 and α', with high and low aluminum content respectively [1, 4].

The martensitic transformation from β phase to 18R martensite can be induced by cooling, spontaneous transformation, or under mechanical stress. The spontaneous transformation occurs with the formation of 24 self-accommodates variants of 18R martensite without macroscopic change of shape. It begins at a martensite-start temperature (Ms). The martensite variants have identical crystal lattice but they can appear in different orientations. By the application of mechanical stress, on tension or compression, β phase transforms to 18R martensite with a macroscopical change of shape [5]. When the material in β phase is subjected to stress, it first elastically deforms and for higher stresses the martensitic transformation of β to 18R martensite is carried out. The stress corresponding to the end of the linear elastic regime is usually referred as the martensite-start stress (σ_s). The sample in β phase is loaded up to a maximum stress (σ_{max}) and then the load is removed. Under appropriate conditions, a hysteretic loop is obtained after unloading with almost complete strain recovery, leading to a pseudoelastic cycle. The pseudoelastic strain (ε_{ps}) can be define as the total applied strain discounting the elastic contribution [5]. There is a limit for the complete recovery of the applied deformation, which depends among other factors on the microstructural characteristics of the sample, the experimental conditions and the composition of the alloy. From therein more, strain is increasingly retained on unloading, due to the presence of martensite needles that could not retransform to β phase and remain retained