V. Neubert, A. Bakkar

Corrosion studies on alumina and carbon fibers/magnesium metal matrix composites

Alumina magnesium metal matrix composites are a precious alternative for aerospace and automotive applications because of their high stiffness-to-weight ratio. A considerable deal of investigations had been devoted to their processing and mechanical properties, while the corrosion behavior is still uncertain. In this study, the corrosion behavior of Al_2O_3 fibers strengthened magnesium AS51composite, in aqueous solutions containing various concentrations of NaCl at different pH values, was studied and compared with the behavior of pure AS51 matrix alloy using electrochemical techniques, hydrogen evolution test, optical microscopy and scanning electron microscopy (SEM), coupled with EDX and WDX capabilities. The results showed that the corrosion behavior of the composite was comparable to its pure matrix alloy, yet a rather reduction in the corrosion resistance was towards the composite at higher chloride concentrations. The corrosion mechanism involved, as well as the corrosion characteristics, was extensively discussed in terms of the effect of Al_2O_3 fibers, and furthermore, an appropriate model describing the corrosion mechanism was proposed as well.

The corrosion behavior of carbon fibers reinforced MMC was investigated with emphasis on the galvanic corrosion arisen between the magnesium matrix alloy and the carbon fibers. The susceptibility of carbon/magnesium interface to degradation was also ascertained. The corrosion behavior was studied in both neutral and alkaline aqueous solutions containing different amounts of NaCl, using electrochemical techniques, hydrogen evolution test, optical microscopy and SEM coupled with EDX and WDX capabilities. Two matrix alloys were used, AS41 and AS41(0.5%Ca). The latter monolithic alloy had a significantly higher corrosion resistance marked by Ca-addition, but the presence of carbon fibers in MMCs invalidated the beneficial effect of Ca. Carbon as an electrically conductive element, is electrochemically unstable despite its almost chemical stability in aqueous chloride environments. Therefore, the polarization diagrams of MMC’s were demonstrated in terms of the electrochemical activity of carbon fibers. This necessitated performing the electrochemical polarization tests, individually, on Mg MMC, monolithic magnesium matrix alloy and carbon fibers electrode.