Corrosion behavior of Al-TM complex metallic alloys

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Binary Al–TM alloys (TM = transition metal) belong to a recently discovered group of complex metallic alloys (CMA). These materials are composed of structurally complex intermetallic phases with large unit cells, inclusive of quasicrystals. Because of their complex crystal structure, the properties of these materials differ from traditional alloys. Corrosion studies of CMA are limited. Only few investigations have been conducted so far in spite of their significance for technological applications of these alloys.

In the current work, we studied the corrosion performance of Al-Co and Al-Pd alloys in saline solutions. Six Al-Co alloys and three Al-Pd alloys were prepared from high purity lumps of Al, Co and Pd by arc–melting. The as-cast alloys microstructure and phase occurrence were investigated by a combination of scanning electron microscopy and room-temperature X–ray diffraction. The alloys were found to consist of several microstructure constituents with different chemical composition. Structurally complex intermetallic phases have been identified. The alloys phase occurrence has been discussed based on both previously published Al–TM phase diagrams and non–equilibrium processes taking place during casting.

The Al-Co and Al-Pd alloys were corrosion tested in aqueous NaCl solution (3.5 wt %) at 21 °C. The electrochemical polarization was conducted in a standard 3–electrode cell controlled by potentiostat. The corrosion potentials and corrosion current densities were determined by Tafel extrapolation of the experimental polarization curves. A pitting corrosion has observed on the alloy surfaces, with some of the phases being preferentially corroded. The effect of the phase chemical composition has been evaluated. The local nobility of individual intermetallic compounds is discussed. Finally, the conclusions for the alloys corrosion resistance in marine environments are provided.

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