

Fabrication and Characteristics of Magnetic Films from the Room Temperature Molten Salt Electrolytes

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Abstract

The electric conductivity of molten mixtures including $\text{AlCl}_3\text{-BPC-CoCl}_2$ was measured using a direct-current computerized method. The conductivities of all the melts studied increased with the increasing of temperature. The electrodeposition of Co/Al films from the $\text{AlCl}_3\text{-BPC}$ melt containing CoCl_2 has been studied by cyclic voltammetry. It was shown that the compact and smooth Co/Al thin films could be obtained at deposition potential of -0.4V . The surface morphologies and the composition of the electrodeposition thin films were studied with the techniques of scanning electron microscopy (SEM), atomic force microscopy (AFM) and energy-dispersive spectroscopy (EDS). The magnetic properties of the deposited thin films have been investigated with magnetic force microscopy (MFM) and vibrating sample magnetometer (VSM). It was shown that the higher magnetization and smooth domains of Co/Al alloys could be obtained at the deposition potential of -0.1V and -0.4V , respectively.

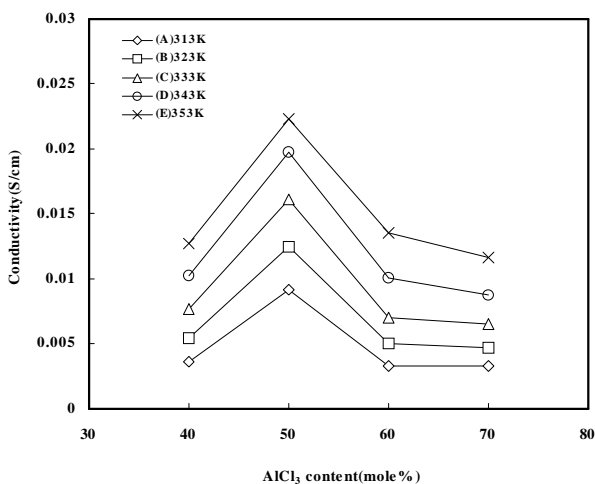


Fig. 1. The electric conductivity of the molten mixture as a function of $\text{AlCl}_3\text{-BPC-CoCl}_2$ mole % ternary melts at different temperatures. (A), 313K; (B), 323K; (C), 333K; (D), 343K; (E), 353K.

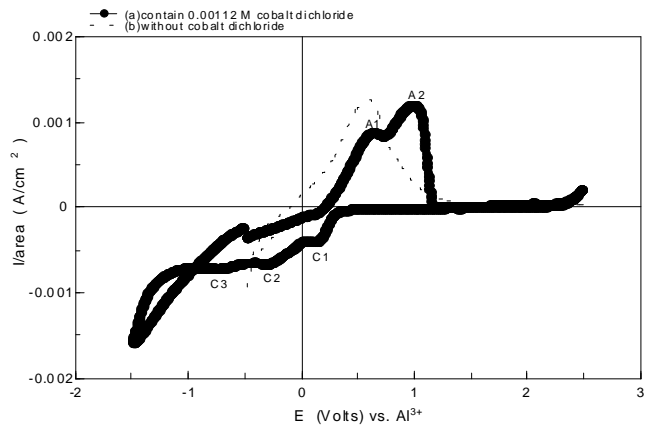


Fig. 2. Cyclic voltammograms recorded at tungsten electrode in molten 70:30 $\text{AlCl}_3\text{-BPC}$ contain 1.12×10^{-3} mole/l CoCl_2 melt at 40°C ; scan rate 400 mV/s .

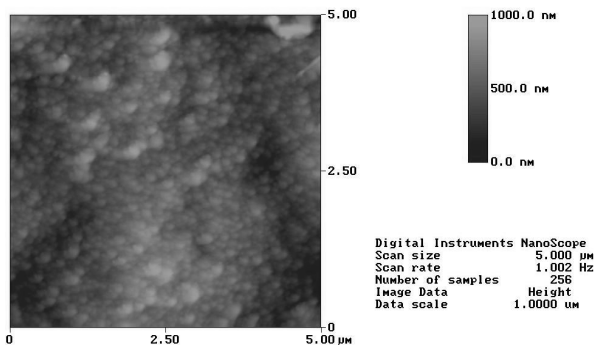


Fig. 3. Atomic force micrographs of the electrodeposited Co-Al alloys in ternary molten salts on Cu plate at 40°C . The experimental condition: $\text{IP} = -0.4\text{Volts}$, $\text{Q} = 10\text{ Coulombs}$.

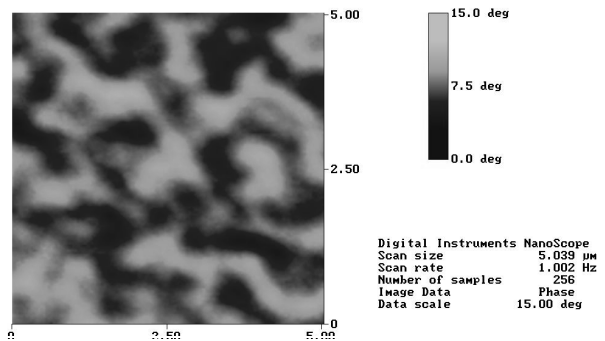


Fig. 4. Magnetic force micrographs of the electrodeposited Co-Al alloy in ternary molten salts on Cu plate at 40°C . The experimental condition: $\text{IP} = -0.4\text{Volts}$, $\text{Q} = 30\text{ Coulombs}$.

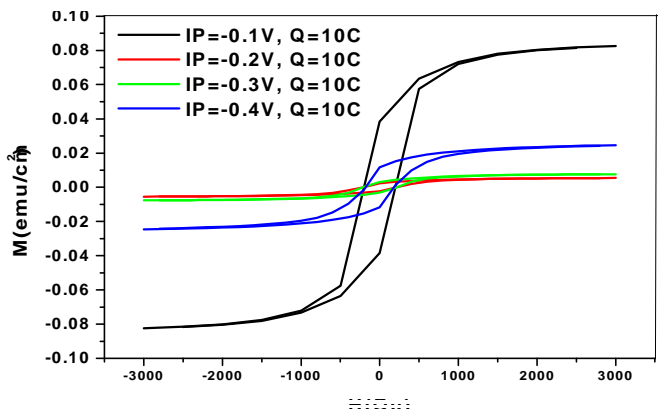


Fig. 5. Hysteresis loop for electrodeposited Co-Al alloys in ternary molten salts on Cu plate.