전산모사를 활용한 Fe-Cr-Ni 전주용 수용액의 안정성 분석

Computational Analysis of Aqueous Solution Stability for Electroformed Fe-Cr-Ni Thin Layer

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Abstract : Computational analysis of aqueous solution stability of Fe-Cr-Ni system to find an electroplating condition of Fe-Cr-Ni layer. Aqueous sulfate solution with iron, chromium and nickel ions was selected by using a numerical S/W with which aqueous solution stability was analyzed. Several possible conditions to perform electro-forming of Fe-Cr-Ni were selected with thermo-dynamical data. The Fe-Cr-Ni system was electro-formed which composition and microstructure of the electroplated Fe-Cr-Ni significantly depended on the solution temperature and electro-potential. The final composition of Fe-3%Cr-48%Ni with less than 30 ㎛ thick was well electroplated.

1. Introduction

Although Fe-Cr-Ni alloy has excellent corrosion resistance, it is difficult to produce thin foil less than 50 micro-meter thick by mechanical rolling. In this study, computational analysis of aqueous solution for the preparation of thin Fe-Cr-Ni foil by electro-forming was carried out to find an optimum condition to produce the Fe-Cr-Ni foil.

2. Approach Method

Analytical program was applied by Pourbaix' approach based on thermodynamical data in which hydrogen ion and metallic ion activities of sulfide-chloride solutions were considered. Number of possible phases at a given temperature were considered and common area for the phase was determined at a given electropotential and hydrogen ion activity [1]. For the verification of the numerical approach, feasible conditions selected by S/W, electroplating were carried. Final phase identification was performed by X-ray florescence spectroscopy (SII Xano technology Inc., SEA 1000A, Japan). Microstructure of the electroforming layer was observed by scanning electron microscopy (Jeol, JSM 6400, Japan).

3. Results

The analytical S/W based on numerical approach was well agreement with Pourbaix diagram, especially Metal-H_2O diagram. For given electroplaing conditions with a solution containing several chemicals like K_2SO_4, $Cr_2(SO_4)_3$, $NiSO_4$, $FeSO_4$ produced Fe-Cr-Ni layer. The concentration of chrome in the Fe-Cr-Ni was in the range of 5 to 25%, which dependent upon the plating temperature. Surface cracks were also present which amount depended on the chrome concentration.

References

1. H. C. An, C. J. Hsuan, C. C. Yu, M. Joachim, Thin Solid Films, 554 (2013) 69-73.