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Effect of bath temperature on structural and magnetic properties of electrodeposited NiCoS magnetic thin films

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Abstract: Nano crystalline Ni-Co-S alloy thin films were deposited on the copper substrate at different temperature by electrodeposition method. Electro deposited Ni-Co-S thin films were subjected to the structural, mechanical and magnetic characterization analysis. The chemical composition of the coated films was analysed by EDAX. The surface and structural morphology of the coated film were analyzed by using SEM and XRD. The mechanical properties of NiCoS films have been studied by VHT. The magnetic properties of thin films have been analysed by VSM. The electroplated NiCoS thin films were strongly adherent to the copper substrate The SEM pictures of NiCoS thin films show that, the deposits of thin films are crack free, uniform and bright surface with fine grain size. All the electro deposited Ni-Co-S films exhibit FCC crystalline structure with crystalline size in the order of nano scale. The VSM result of NiCoS thin films shows that the NiCoS thin films coated at high bath temperature have highest saturation magnetisation value with lower coercivity. Due to highest magnetisation value with low coercivity, NiCoS thin films can be used for the manufacturing of MEMS and NEMS devices.

Keywords: Thin films, characterization, electrodeposition, crystalline size , temperature ,X-ray diffraction, Micro hardness, , Surface morphology.

1. Introduction

Electrodeposition has become the dominant manufacturing technology in many new applications such as micro electromechanical system (MEMS) devices, nano electromechanical system (NEMS) devices, data storage media and magnetic recording head. Electrodeposited nickel is one of the most widely used materials in the fabrication of micro machines such as micro cantilevers, micro gears and their components (3-5). The most commonly used magnetic materials in MEMS and NEMS are soft magnetic materials, such as NiCo ,NiFe and NiP (4-6) .The combination of low coercivity (low hysteresis loss), relatively high magnetic saturation and good corrosion resistance has led to the use of electroplated NiCo films in microscopic sensors, actuators and systems (7). The use of NiCo as the soft film can be improved by adding a third element with NiCo alloy. In power electronics industry, CoNiS thin films are the suitable materials for the production of super capacitors. Sulfur is the suitable stress reducing agent for NiCo based thin films. It is important to develop new electrode materials with desirable super capacitor properties, such as high electrical conductivity, porous structure, large capacitance and good electrochemical stability. The development of ternary nickel cobalt sulfides with controllable composition by electrodeposition method and their application as positive electrodes improve super capacitors with excellent energy storage properties In this current investigation, the electrodeposition method has been chosen for coating Ni-Co-S thin films. In this work, thiourea is used as a source material for Sulfur . In