Microstructure and material properties of electroless CoWP films obtained from sulfamate solutions

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Abstract

This work describes the development of a thin film cobalt–tungsten–phosphorous (Co–W–P) alloy, deposited from an electroless deposition solution and the study of the effect of the solution composition and deposition parameters on the microstructure, electrical and magnetic properties of the deposits. Electroless deposition of CoWP was performed on copper surface from novel electroless bath with cobalt sulfamate $Co(NH_2SO_3)_2$ as a source of Co ions and sodium tungstate as a source of tungsten. The reducing agent and a source of phosphorous was sodium hypophosphite. The developed electroless solution produces high quality cobalt alloy films with the ability to form 2–2.5 μm thick soft magnetic layers. The CoWP deposition rate was found to decrease with the increase of sodium tungstate concentration. The maximum tungsten content in the film was about 1.9 at.%. The influence of the tungsten concentration in the solution and post-deposition vacuum annealing on film morphology, surface topography, composition, magnetic properties and resistivity was studied. The resistivity of the CoWP layers shows a strong non-linear dependence on the film thickness. The resistivity of the as-deposited films was in the order of 10^{-4} Ω cm and it decreased by about a factor of two after vacuum annealing at 400 °C for 2 h. The corresponding evolution of the film structure and morphology is

presented and discussed. The CoWP deposit demonstrated high temperature stability up to 350 °C during annealing in air.