Electrolessly Deposited CoZnWP Films Having High Coercivity and High Corrosion Resistance

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Cobalt alloy thin films are widely used as a magnetic recording medium, such as hard disks for computers. The electroless (autocatalytic) deposition method has advantages of uniform deposition on large and insulating substrates, and simple and low cost process. The addition of Zn into electroless CoP alloy films improved the coercivity of films (1,2). The addition of W is expected to progress the corrosion resistance of films. In this study, CoZnWP alloy films have been prepared as the films having both high coercivity and high corrosion resistance.

EXPERIMENTAL Pickled copper plates and stainless steel plates were used as substrates. The Co alloy films were deposited in an electroless solution containing 0.05 M (M: moł dm^{-3}) $CoSO_4$, 0 - 0.06 M Na_2WO_4, 0 - 1.0 M $ZnSO_4$, 0.1 - 0.6 M NaH_2PO_2, 0.5 M sodium tartrate, and 0.5M $(NH_4)_2SO_4$. The pH was adjusted to 10.5 with NH_4OH and the operating temperature was 348 K. The thickness of films was ca. 3 μm. The deposited films were corroded by immersing into 0.1 M H_2SO_4 solution. The corrosion rate was determined by measurement of the magnetic moment of films with a magnetic valance before and after the corrosion. The composition of deposited films was measured by the ICP emission spectroscopic analysis. The coercivity of films was measured with a vibrating sample magnetometer.

RESULTS The corrosion rate of electrolessly deposited CoP alloy films increased with the P concentration in the films. Thus, the P concentration was controlled to be 7±1 at % for subsequent experiments. The addition of 0.2 at % of Zn into the CoP films considerably accelerated the corrosion of the films from 0.8 to over 10 nm s^{-1}. The addition of 1.7 at % of W into the CoP films reduced the corrosion rate to 0.09 nm s^{-1} (○ of Fig. 1). The corrosion rate of CoZnWP films increased with Zn concentration (▲ of Fig. 1). The W concentration of CoZnWP films was higher than that of CoWP films. XPS analysis indicated that Co oxide and WO_3 (Fig. 2) were formed on, and Zn was eluted from the surface of CoZnWP film by the corrosion. These results show that the passive W oxide improves the corrosion resistance of films.

The coercivity of CoWP films was ca. 28 kA· m^{-1} and independent of the concentration of W. The addition of about 1 at % of Zn into the CoP and CoWP films enlarged the coercivity of the films to over 60 kA· m^{-1}, as shown in Fig. 3. Thus, the high coercivity and high corrosion resistance CoP alloy films can be produced by the electroless deposition with few % of W and Zn.

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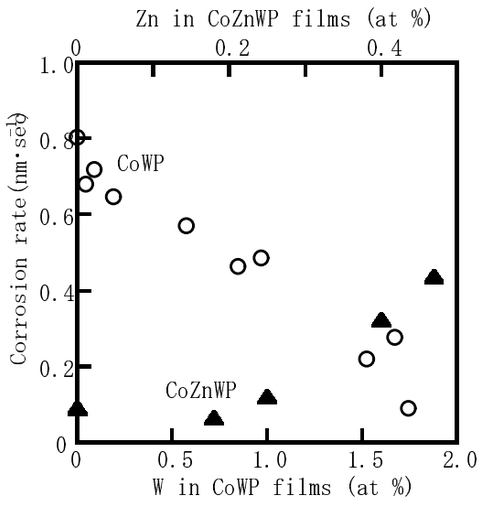

Figure 1. Corrosion rates of electrolessly deposited Co alloy films vs. concentration of W in CoWP (○) and Zn in CoZnWP (▲) films. The concentration of W in CoZnWP films was 1.9 - 2.1 at %.

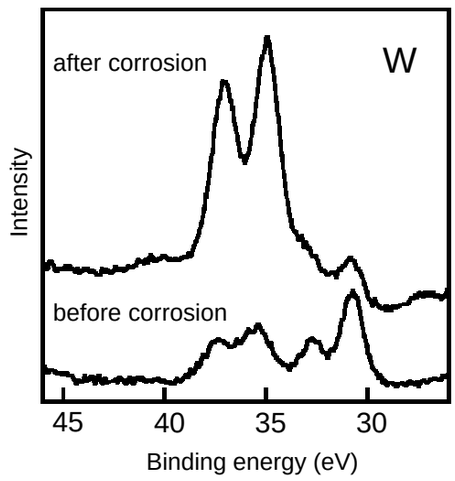

Figure 2. XPS spectra in the W4f region for electrolessly deposited CoZnWP films before (lower curve) and after the corrosion (upper curve).

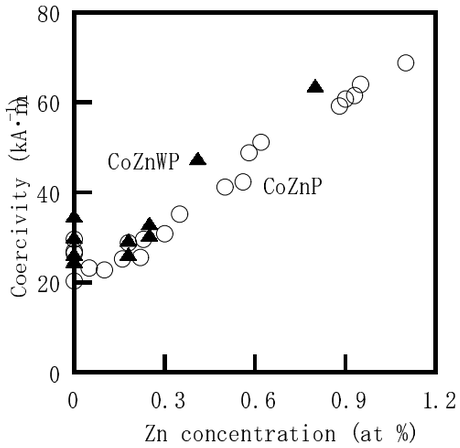

Figure 3. Coercivity of electrolessly deposited CoZnP (○)

and CoZnWP (▲) films as a function of Zn concentration.