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**Characteristics of CuNi alloy deposited by magnetron sputtering for thin film resistor**

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Copper-nickel alloys with a composition similar to the commercial alloy (constantan) are used for resistive and thermoelectric applications.[1-3] Recently, it has been applied in thin film configurations for resistive components. Low resistivity and low temperature coefficient of resistance (TCR), which guarantee low and constant electric resistance over a wide range of temperature, are required in microelectronics, especially in portable terminal or telecommunication devices, for the purpose of saving the consumption of batteries. Thin films of CuNi with approximately 40 wt% Ni have a resistivity ( ρ ) of about 50 μΩ·cm and a small temperature coefficient of resistance below 50 x $10^{-6}$/K. These properties are influenced by not only the composition but the microstructure of the films. Most pure metals have a positive TCR of several thousand ppm/K. By alloying, the TCR can be reduced and negative TCR occurs in several amorphous metals and in other metastable states like the so-called quasicrystalline materials.[4] The TCR accuracy depends in the precision in both annealing treatment and film composition. Also the degree of amorphism may depend on sputter conditions and therby influence on the final TCR.[5]

Films were deposited by dc magnetron co-sputtering with Cu and Ni targets of 2 inch diameter. Oxidized silicon wafers with (100) orientation and an oxide thickness of 0.2 μm were used as substrates. The dc power of Cu was maintained at 50 W and variation of composition as a function of Ni power. Their structural and electrical properties are investigated with the variation of composition and annealing temperature in 3 x $10^{-6}$ Torr. The CuNi thin films for measurement of were patterned using metal masking. The CuNi structure and Pt electrode pattern for four-terminal resistance measurements was shown in Fig. 1. TCR of the samples was measured through a heating and cooling procedure from 25 to 120°C in thermostatically controlled oven using a digital miltimeter (HP3458A). TCR values were clcu

Figure 2 shows the variation of composition as a function of Ni power in 400 nm thick-CuNi thin films. The dc power of Cu was constantly maintained at 50 W. as shown in Fig. 2, Ni concentration in CuNi thin films increases linearly with increasing Ni power. A constantan composition of $Cu_{54}Ni_{46}$ showing an near zero TCR was obtained at an Ni power of 100 W and Cu power of 50 W.

Figure 3 shows the TCR measurement of CuNi thin films with deposition temperature.

Sample with this composition are characterized for the structural and electrical properties of thin film resistors.

**References**

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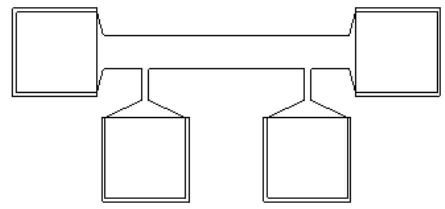

*Fig. 1 Resistor and electrode pattern for four-terminal resistance measurement.*

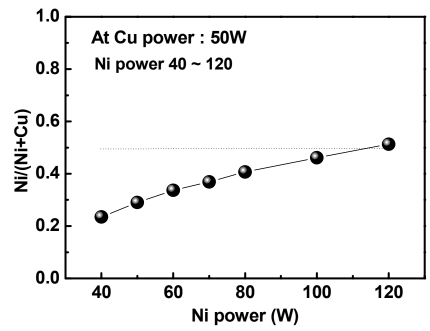


*Fig.2 Variation of composition as a function of Ni power*

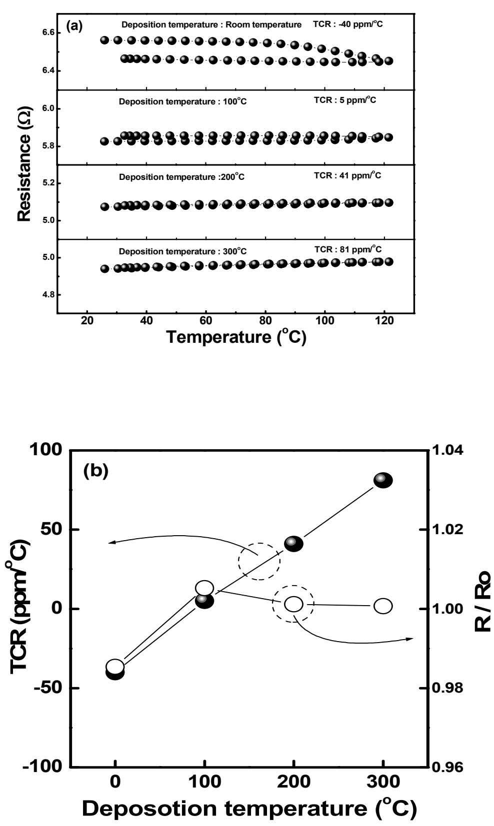


*Fig. 3 Dependence of the (a) TCR and (b) TCR vs resistrance for CuNi films on the deposition temperature.*