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자성코아를 이용한 dual spiral type 박막인덕터의 특성

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Characteristics of dual spiral type thin film inductors using magnetic cores

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1. Introduction

Since the fabrication process is simple, spiral type thin film inductors with air core have been widely investigated for micro-magnetic components in electronic equipment in spite of low inductance [1]. In order to increase the inductance without deteriorating the fabrication process, we fabricated dual spiral type thin film inductors using nanocrystalline $Fe_{86.1}B_{2.4}N_{11.5}$ magnetic cores.

2. Experimental procedures

For the fabrication of thin film inductors, Cu as a conductor was deposited by an electroplating method and magnetic cores were fabricated on a SiO_2(1 μm)/Si wafer by N_2 reactive rf magnetron sputtering using a composite target. For seed layers, Cr and Cu layers were consecutively sputter deposited. During the procedure of the sputtering, the basal pressure and Ar working partial pressure were maintained at 1×10^{-6} Torr and 1 mTorr, respectively.

The saturation magnetization ($4\pi M_s$) and the coercivity (H_c) of films were measured by a vibrating sample magnetometer. The effective permeability (μ_{eff}) and the electrical resistivity (ρ) were measured by the 8-figure coil method and the four-point probe method, respectively. The composition of films was analyzed using an Auger electron spectroscopy. The inductance, resistance and quality factor were measured by the 4192A LF impedance analyzer with a probe station.

3. Results and Discussion

As-deposited 3 μm thick $Fe_{86.1}B_{2.4}N_{11.5}$ film shows good soft magnetic properties, $4\pi M_s \sim 17.1$ kG, $H_c \sim 1$ Oe, $\rho \sim 90$ μΩcm and $\mu_{eff} \sim 1700$ at 10 MHz.

Figure 1 shows the typical structure of the fabricated thin film inductor with a dual spiral coil

structure sandwiched by magnetic thin films (thin film inductors with dimensions of 3 mm × 3 mm × 35 μm, conductor coil with 100 μm × 10 μm cross-sectional area). The films and the coil are insulated by polyimide films.

The Characteristics of the inductors in the variations of frequency and coil turns are shown in figure 2. The resistance (R_{DC}) is 1~2 Ω. The inductance and the quality factor are obtained in the range of 1.8~2.0 μH and 20~30 at 10 MHz, respectively. These results are well matched with simulation results. Therefore, the thin film inductors using $Fe_{86.1}B_{2.4}N_{11.5}$ magnetic cores are applicable to a dc-dc converter at MHz range.

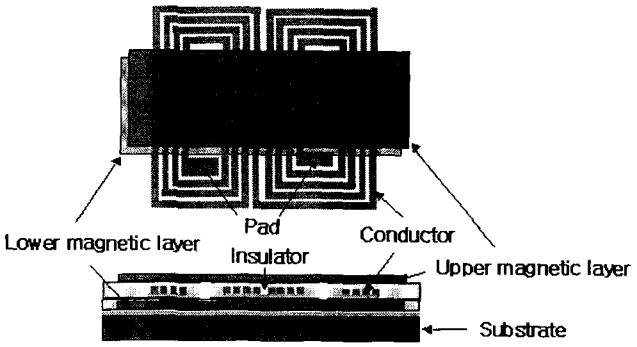

Fig. 1. Structure of the fabricated dual spiral type thin film inductor.

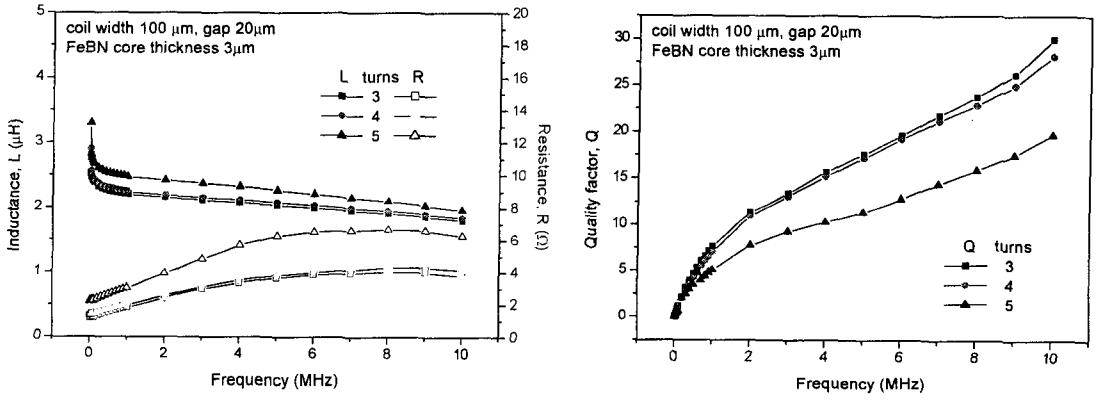

Fig. 2. Frequency characteristics of L, R, Q values in the thin film inductors.

4. Reference

[1] H. J. Ryu, J. J. Lee, J. Kim, S. H. Han, H. J. Kim, J. Magn. soc. Japan, vol. 23, No. 1-2, pp 258-260 (1999)