

Soft Magnetic Applications for RF IT devices

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Huge applications of soft magnetic films can be expected as integrated passives in the latest IT devices, including CMOS compatible RF integrated inductors and transformers, transmission line devices, electromagnetic noise countermeasure, sensors, etc. A new 1MHz-9GHz permeameter has been completed and clarified the possibility of modern magnetic films for applications in integrated passives. The films evaluated include CoNbZr, CoZrO, CoAlPdO, electroplated NiZn(Co) ferrite, etc.

Two types of RF integrated magnetic thin-film inductors were microfabricated on high resistivity Si wafer ($\rho > 500 \Omega \text{cm}$.) The sandwich type one port spiral inductor has a four turn and $400 \times 200 \mu\text{m}^2$ size copper spiral coil with cross sectional dimension of $8 \times 3 \mu\text{m}^2$. The coil was sandwiched by the $0.1 \mu\text{m}$ thick $\text{Co}_{85}\text{Zr}_{12}\text{Nb}_3$ amorphous film with narrow slit train along easy axis direction to enhance the ferromagnetic resonance frequency. The inductance exhibited was 19% better (7.9nH) and the quality factor was 23% better (12.7) than air-core inductor of the same dimension. On the other hand, an equivalent circuit analysis was performed for a simple on-top type two-port spiral inductor in a 100MHz-5GHz range, which clarified the parasitic capacitances and resistances as well as the main inductance and resistance. It was significant that the magnetic film enhanced the inductance up to 5GHz. A New structure shown in Fig. 1 will also be discussed at the presentation..

Low μ_r' and high μ_r'' are requested for integrated electromagnetic noise countermeasure is also proposed. Possible configuration is to integrate the magnetic film on to a RF transmission line. The ideal role of magnetic film is not to raise insertion losses in the pass-band and to give as large attenuation as possible at the stop-band. Experimental and simulation results suggest this application should be possible up over 10GHz.

This work was supported in part by the Japan-Korea Basic Scientific Cooperation Program (JSPS), The Grant-in-Aid Scientific Research, No. 12305025 (JSPS) and No.13025202 (Minst. Educ., Cult., Sports, Sci. & Tech.), Telecommunications Advancement Organization (TAO) of Japan, and Ministry of Education, Culture, Sports, Science and Technology.

