# Lithium Ferrites for Phase Shifter

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The dramatic development of satellite television has attracted people's profound attention on the receipt of satellite television programs by motion carriers such as trains and long distance buses. Meanwhile, to develop the remote education system in our nation so that the border areas can receive satellite television programs, we have conducted research on flat plate phase array antenna system of autotrack synchronous communication satellite. However, the development of this system is dependent greatly on the quality and materials of component. Therefore, we have conducted deep discussion on materials of phase shifter.

Using standard ceramic technique on pure oxide: $ZNO$, $TiO_2$, $SnO_2$, $Fe_2O_3$ and carbonate $Li_2CO_3$ as raw materials, we prepared the $Li_{0.5(1-y)}Zn_yFe_{2.5(1-0.2y)}O_4$ Lithium ferrites (with $y = 0$, 0.1, 0.16, 0.25, 0.28) and Kuband Ferrite phase shifter materials $Li_{0.625}Zn_{0.1}Ti_{0.25}Sn_{0.1}Fe_{1.925}O_4$. Flowing-oxygen begins at 800°C to 900°C and the pressure of wet pressing is about $9.8\times10^{11}$ Pa. The temperature of flowing-oxygen sintering is from 850°C to 1050°C and some beneficial materials: $Bi_2O_3$, $NiO$, $Co_2O_3$ and $MnCO_3$ are added.

Through the analysis of the $X$-ray diffraction, it is shown that all generating materials are monophasic Lithium ferrites. The test results of $Li_{0.625}Zn_{0.1}Ti_{0.25}Sn_{0.1}Fe_{1.925}O_4$ ferrite at 300 K are tabulated in Table 1. Figure 1 shows the relation between specific saturation magnetization of $Li_{0.625}Zn_{0.1}Ti_{0.25}Sn_{0.1}Fe_{1.925}O_4$ and temperature. Figure 2 gives the relation between saturation magnetization of $Li_{0.5(1-y)}Zn_yFe_{2.5(1-0.2y)}O_4$ and substituent $y$.

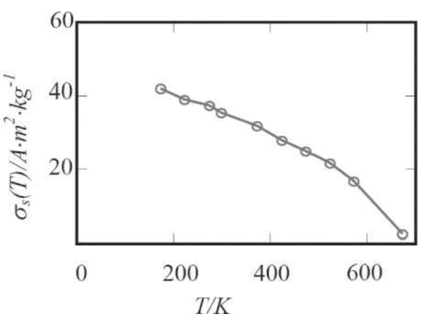


Figure 1: Relation between specific saturation magnetization $\sigma_s$ and temperature $T$.

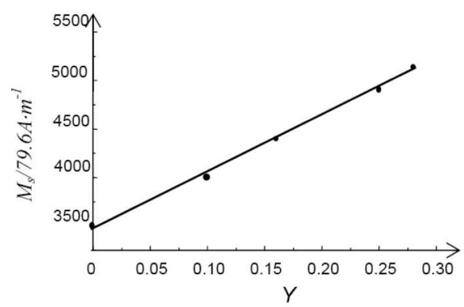


Figure 2: Relation between magnetization $M_s$ and substituent $y$.

Table 1: Test results of $Li_{0.625}Zn_{0.1}Ti_{0.25}Sn_{0.1}Fe_{1.925}O_4$ ferrite at 300 K.

| Sample | g | $R_r$ | $H_c$ | $\rho$ | $\varepsilon'$ | $tg\delta_\varepsilon$ | $M_s$ | $\Delta H$ | $T_c$ |
|---|---|---|---|---|---|---|---|---|---|
| $Li_{0.625}Zn_{0.1}Ti_{0.25}Sn_{0.1}Fe_{1.925}O_4$ | 2.0 | 0.9 | 0.7 | 4.5 | 16.2 | 4.2 | 2060 | 285 | 678 |

It is shown from above analysis that magnetic dipole moment of ferrite $Li_{0.5(1-y)}Zn_yFe_{2.5-0.2y}O_4$ is equal to the magnetic dipole moment difference of $Fe^{3+}$ on B sites and $Fe^{3+}$ on A sites, which is to say, the number of Bohr magnetons per unit molecular formula in $(Zn_yFe_{1-0.5y})$ $[Li_{0.5(1-y)}Fe_{1.5}]O_4$ ferrite is $n_B = 1.5-1+0.5y = 0.5(1+y)$, an increase in $y$ will increase $n_B$, therefore, saturation magnetization increase linearly with the increase of substituent $y$. However, the saturation magnetization is decreased when $y$ is increased to such an extent that the super-exchange interactions of $Fe^{3+}$ on $A$ and $B$ sites become weak owing to excessive concentration of nonmagnetic $Zn^{2+}$ ions, leading to a incline of $Fe^{3+}$ magnetic dipole moment and a partial spinflip.

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