# 摘要

在本論文中，我們利用溶膠凝膠法與固態反應法製備Pb(Zr0.1Ti0.9)O3-(Mn0.7Zn0.3)Fe2O4磁電複材，並觀察其微結構、熱膨脹係數、及磁電性質的變化。

PZT-MZFO電複材經過6時不同溫度燒結，相對密度在相同的複合比例下，固態反應法所製備之磁電複材性質皆大於溶膠凝膠法。由SEM和EDS的微結構及成分分析，可以得知複材內的大晶粒皆為MZFO，小晶粒皆為PZT。熱膨脹係數絕對值在相同的複合比例下，固態反應法製備之複材皆小於溶膠凝膠法的，最小值出現在溶膠凝膠法製備的0.75PZT-0.25MZFO時，其值為1.737 ppm/℃。

介電常數和介電損失都會隨著添加PZT而增加，溶膠凝膠法製備的純PZT有最大的介電常數265.956。固態反應法製備的純MZFO有最小的介電損失0.001205。

磁電複材在共振腔內不同頻率下，對導磁率與磁損率量測結果有顯著的影響。導磁率和磁損率都會隨著添加PZT而降低，在頻率為7.5 GHz時，固態反應法製備的純MZFO有最大的導磁率1.0008281，0.75PZT-0.25MZFO有最小磁損率，其值為1.75。

關鍵詞：磁電複材、熱膨脹係數、介電性質、磁性質。

# ABSTRACT

In this study, we reported on the microstructures, thermal expansion coefficients, dielectric properties, and magnetic properties of Pb(Zr0.1Ti0.9)O3-(Mn0.7Zn0.3)Fe2O4 magnetoelectric composites prepared by sol-gel method and solid state method.

The composites were sintered for 6 hours at various sintering temperatures. At the same the same composite ratio, the relative densities of the composites prepared by solid state method are higher than those of the composites prepared by sol-gel method. The large grain is MZFO and small grain is PZT in the composites which are proved by SEM and EDS. At same composite ratio, the absolute value of the thermal expansion coefficients of composites prepared by solid state method are lower than those of the composites prepared by sol-gel method. 0.75PZT-0.25MZFO prepared by sol-gel method results in a minimum value of 1.737 ppm/℃.

Dielectric constant and loss tangent increase with the doping amount of PZT. Pure PZT prepared by sol-gel method results in a maximum dielectric constant of 265.956. Pure MZFO prepared by solid state method results in a minimum dielectric loss tangent of 0.001205.

The permeability and loss of permeability of magnetoelectric composites are significantly affected under different resonator frequencies. Permeability and loss of permeability decrease with increasing doping amount of PZT. When frequency is 7.5 GHz, pure MZFO and 0.75PZT-0.25MZFO prepared by solid state method result in a maximum permeability of 1.0008281 and a minimum loss of permeability of 8.57, respectively.

Keywords: magnetoelectric composites, thermal expansion coefficients, dielectric properties, magnetic properties