Effects of sintering additives and calcination temperatures on the sintering characteristics and microwave dielectric properties of (Zn1-xMgx)TiO3 system

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Abstract

We investigated the low-temperature sintering and microwave dielectric properties of (Zn1-xMgx)TiO3 with sintering additives such as Bi2O3+ V2O5 and B2O3. Highly dense samples were obtained for (Zn0.8Mg0.2)TiO3 at the sintering temperature range of 870900 with Bi2O3 and V2O5 additions of 1 wt.%, respectively. They consisted of hexagonal (Zn,Mg)TiO3+ ZnTiO3 as a main phase when 0.45 wt.%Bi2O3 and 0.55 wt.%V2O5 were added and sintered at 870 and 900. The microwave dielectric properties of (Zn0.8Mg0.2)TiO3 with 0.45 wt.%Bi2O3 and 0.55 wt.%V2O5 sintered at 900 were as follows: Q∗fo=50,800 GHz, r=22, and f=-53 ppm/. In order to improve temperature coefficient of resonant frequency, TiO2 was added to the above system. The optimum amount of TiO2 was 15 mol.% when sintered at 870, at which we could obtain following results: Q∗fo=32,800 GHz, r=26, and f=0 ppm/. We studied the effects of calcination temperatures on the sintering behaviors and microwave dielectric properties of (Zn0.8Mg0.2)TiO3 with Bi2O3+ V2O5 system. From the examination of the existing phases and microstructures before and after sintering of (Zn0.8Mg0.2)TiO3 system which was calcined at the various temperatures ranging from 800 to 1000, it was found that higher Q∗fo values were obtained when unreacted phases in calcined body were reduced. When calcined at 1000 and sintered at 900, it consisted of hexagonal as a main phase with uniform microstructure and exhibits Q∗fo value of 42,000 GHz and dielectric constant of 22. B2O3 addition to (Zn0.8Mg0.2)TiO3 ceramic system also lowered the sintering temperature and highly dense samples with hexagonal as a main phase were obtained at the sintering temperatures below 910. f changed to a positive value with increasing the amount of B2O3 because of the increased amount rutile phase. The Q∗fo values were determined by the microstructures and sintering shrinkages which were affected by the rutile or second phase(MgB4O7). When 6.19 mol.% of B2O3 were added and sintered at 910 for 5h, it exhibits r=23.6, Q∗fo=53,000 GHz, and f=0 ppm/.