Structure and Microwave Dielectric Properties on ALa$_4$Ti$_4$O$_{15}$ (A=Ba, Sr and Ca)

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Developments of microwave dielectrics for base station are desirable because of increasing amount of cellular phone. The materials are expected to have high quality factor (Q) and high dielectric constant (Σ_r). We have reported a candidate of homologous compounds Sr-doped $BaLa_4Ti_4O_{15}$ with high Q•f of 46000GHz, high Σ_r of 46, and a temperature coefficient of resonant frequency τ_f of -11 ppm/˚C. On the other hand the τ_f can be improved to near zero: 1.3 ppm/˚C with high Σ_r of 44 and Q•f of 47000 GHz by substituting Al ions. And when Ba ions are substituted by Sr, it also shows good: Q•f = 46220 GHz, Σ_r = 43.7, and τ_f = -8.4 ppm/˚C. The crystal data of Ba-system are as follows: crystal system: trigonal, space group: $P\ \bar{3}c1$, and lattice constants: a =5.609 Å, c = 22.648 Å. This crystal structure belongs to hexagonal layered perovskite-type structure. The packing layer with oxygen and La/Ba atoms is stacked by two types. One is cubic ABCABC stacking for perovskite layer and hexagonal ABAB stacking for junction slabs which is composed three octahedral with face contact. There are three positions for Ba/La ions as follows: $A1$ position with La and Ba is located near vacant octahedron, $A2$ position is located next stacking layer, and $A3$ position is occupied the center of perovskite layer. Structures of $BaLa_4Ti_4O_{15}$ substituted Ca and Sr for Ba are also analyzed. And relationship between structure and properties of them are presented.

Keywords: microwave dielectrics, homologuos compound, hexagonal layered perovskite